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ABSTRACT

This document presents the proceedings of the 23rd annual National Convention of the Association for Educational Communications and Technology (AECT) (Denver, Colorado, 2000). For the first time, the Proceedings are published in two volumes. The first volume contains papers dealing primarily with research and development topics. Papers dealing with instruction and training issues are contained in the second volume, which includes over 60 papers. Both volumes are included in this document. Papers in this document represent some of the most current thinking in educational communications and technology, at all levels of education. Topics include: educational research; multimedia instruction; technology integration; cooperative learning; distance learning; teaching models and methods; instructional design; academic achievement and student motivation; technology-based educational change; learner feedback; faculty development; computer-assisted instruction; gender role; constructivism; assistive technology; mentoring; problem-based learning; partnerships in education; the Big Six Skills; online systems in education; needs assessment; communities of learners; digitization; sound and graphics in computer-based instruction; interactive video; disability access to education; human performance technology; curriculum development; resource centers; privacy; Web page design; computer software development; and virtual libraries. (AEF)

Annual Proceedings of Selected Research and Development Papers Presented at the National Convention of the Association for Educational Communications and Technology (23rd, Denver, Colorado, October 25-28, 2000). Volumes 1-2

Margaret Crawford and Michael Simonson, Editors

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Editors

Margaret Crawford

Media Specialist

Mason City Public Schools

Mason City, IA

And

Michael Simonson

Professor

Instructional Technology and Distance Education

Nova Southeastern University

Fischler Graduate School of Education and Human Services

North Miami Beach, FL

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Preface

For the twenty-third year, the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is sponsoring the publication of the Proceedings. Papers published in this volume were presented at the National AECT Convention in Denver, CO. A limited quantity of these Proceedings were printed and sold in both hardcopy and electronic versions. It is also available on microfiche through the Educational Resources Clearinghouse (ERIC) system.

For the first time, the Proceedings of the AECT's Convention are published in two volumes. Volume #1 contains papers dealing primarily with research and development topics. Papers dealing with instruction and training issues are contained in volume #2, which also contains over 60 papers.

REFEREEING PROCESS: Papers selected for presentation at the AECT Convention and included in these Proceedings were subjected to a reviewing process. All references to authorship were removed from proposals before they were submitted to referees for review. Approximately fifty percent of the manuscripts submitted for consideration were selected for presentation at the convention and for publication in these Proceedings. The papers contained in this document represent some of the most current thinking in educational communications and technology.

M. R. Simonson
Editor

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Exploring Qualitative Methodologies in Online Learning Environments

Mary Beth Bianco
Alison A. Carr-Chellman
Penn State University

Abstract

Qualitative inquiry is rich in personal interaction between participant and researcher. The researcher is an instrument (Creswell, 1998) and the participant an active sharer in the process and in some cases the final interpretation of the inferences, as well. The qualitative methodological processes, particularly those considered the three legs of triangulation – interview, observation and document analysis - vary in the degree and type of communicative aspects in specific contexts. The various methods used in collecting and interpreting qualitative data are best used together - multiple methods. (Denzin and Lincoln, 1998; Creswell, 1998) Using more than one gives the researcher an avenue to corroborate findings and add a deeper dimension to the study. For example, the probing of the interview combined with the interpretation of reports and the interaction of an observation form a more complete picture from which themes and issues emerge, allowing the researcher to tell the story of the participants more accurately and completely. (Denzin and Lincoln, 1998) Will the story be affected with the advent of new technological methods of not only collecting the data, but the data itself?

This discussion seeks to consider the issues related to conducting qualitative inquiries in online settings and the implications for using electronic means in interview and observation. Consideration needs to be given to the ramifications of online interview techniques. "Face-to-face" may not be "face-to-face" in online environments but may be only available other synchronous forms, such as, telephone or online discussion. The implications for electronic discussion formats for conducting interviews will also be discussed.

Triangulation, in the most accepted definition, then, may be implausible due to the fact that the interview or observational techniques are not logistically feasible or probable. Observation in natural settings is foundational to the integrity of the observation but should be investigated for workability as well as rectitude. (Creswell, 1998). Exploration into the implications for observation by electronic means should be conducted to determine the trustworthiness of this new form of data collection.

The methodology issues discussed here are those that relate to the interview and observational legs of triangulation in conjunction with possible avenues for document analysis. Various strategies for testing online qualitative inquires will be considered and discussed related to their potential value to the inquiry process. The inquiry in this case centers on methodological implications for data collection and their impact on the qualitative process in online situations or by electronic means.

Introduction

There are a growing number of research studies being conducted on distance education, in particular, online learning environments (Schlough & Bhuripanyo, 1998; Hengni, 1998;Thompson and Nay, 1999; French, 1999; Moon, 1998; McIssac, et. al., 1999; Truman-Davis and Hartman, 1998; Gunawardena, et. al., 1998; Levin and Ben-Jacob, 1998; Hiltz, 1998; Chen & Mashhadi, 1998; Jannasch-Pennell, et. al., 1999; McFerrin, 1999; Donaldson and Tomson, 1999; Yong, 1998). Online or web-based course delivery is becoming more and more prevalent as an integral part of today's college curriculum. Instructors and university professors are providing more web support and universities are soliciting students to participate in online coursework in the "anytime, anywhere" model of instructional delivery. (Gladieux and Swail, 1999, Dunn, 2000).

As a result of the increased interest in research in the area of online learning, there has been a subsequent increase in the interest in the use of qualitative methods to gain a deeper understanding of online learning environments. In particular, there have been a large number of studies which examined, qualitatively, the student perceptions of online learning experiences (e.g., McNeil & Robin, 2000; McIsaac, et.al., 2000). However, there has not yet been adequate exploration of the use of qualitative methods in online learning environment inquiry.

In an effort to understand student's perceptions of their learning in this emerging environment, much research is being conducted in connection to online learning. Among the current topics of interest are studies which compare online to traditional delivery of the same course material; effectiveness of learning; student perceptions; fostering collaboration; and various course delivery models,.(e.g., Diaz and Cartnal, 2000; Ryan, 2000).

Online learning has both its advocates and its detractors. These new technologies in instructional delivery carry both support for and definite opinions against online learning environments and their potential effect(s) on learning. If learning is at the heart of our choices regarding instructional delivery options, researchers and educators are obligated to fully understand student experiences in many types of learning situations. Student perceptions and experiences should be priorities in the design process and should be strongly considered prior to media selection decisions. It is difficult not to design for the "delivery method d'jour", however no matter how glizty or well-funded online education options may be, their impact on learners' experiences as understood through qualitative inquiry should be carefully considered by all practicing instructional designers.

In an attempt to understand the culture of online-learning, qualitative methodology is a natural choice with regard to research design. The tenets of phenomenology (Denzin and Lincoln, 1998) lead us to deeper understandings of the experiences of the participants and the interpretation that informs our understandings. Phenomenological research assumptions carry with them the importance of the voice of the participant, their descriptions of their experiences, their reflections on their lived experiences. (Creswell, 1998; Moustakas, 1994). In considering online learning environments, these experiences are critical in an attempt to gain deeper understandings. This paper is an attempt to discuss some of the potential implications of doing qualitative research with online populations.

Distance Education – Attitudes and Perceptions

David Noble's (2000) outcry against online learning and technology is largely aimed at the politics of technology. He argues that the technology itself is indeed value-laden and the demand for online education is non-existent, created by university administrators. (Young, 2000) He suggests that the motivations for online learning are nothing more than greed on the part of university administrators and should be resisted by faculty in the same ways that Luddites resisted the new technologies that they believed would put their own children out of future work. Others (Bowers, 1999; Woody, 1999) also argue that while the Internet is an excellent dispenser of information, education is not merely the acquisition of information. By making learning primarily about the acquisition of information, there is the potential to commodify higher education--learning becomes a product for sale rather than the experience of learning and growth. Like Noble, many are concerned for the financial emphasis placed on online learning environments with a lack of focus on "learning". (Noble, 1998; Woody,1998).

Many supporters of online education (Dunn, 2000; Dede; 1997). envision a future where students will come to universities only for the social aspects of higher education, such as sports or other non-academic activities. In a report prepared by the College Board, predictions about the future of online learning environments included the demise of the university, as we know it, within 30 years. (Gladieux and Swail, 1999;Dunn, 2000). Gladieux and Swail go on to cite examples of complete degree programs offered by "traditional" universities online and refers to them as leaders in the electronic market. While considerations need to be made about the access to these new technologies and the target populations who benefit from technological advancement, other issues should be considered as well. The need exists for a qualitative examination of online instruction. Collaboration, social interaction and relationship building activities that exist in face-to-face instruction have been addressed somewhat in design literature

Qualitative methodologies are social at the core (Creswell,1998;Denzin and Lincoln, 1998). There has always been an understanding that part of the qualitative inquiry experience is "being in the field." (Wolcott, 1995). Doing fieldwork, in which the inquirer worked in a natural setting to collect stories by observing, examining documents, and interviewing indigenous populations, has always been a cornerstone of the qualitative research experience.(Lincoln and Guba, 1985). What is the implication of doing qualitative research in online settings? Where is the field? Where is it located? Is it electronic? Collecting data at a distance begs the question - can qualitative research occur in the exploration of online learning and if so, how will that experience be defined? Will qualitative research lose a certain social quality when we translate these methods from naturalistic inquiry (Lincoln & Guba) into e-inquiry? Will the researchers enjoy the experience of doing qualitative research in an e-field as much as they enjoy being in a physical field? Will there be some important essence of the stories that are lost by doing qualitative research electronically? Is there any way to do qualitative research among online populations in a face-to-face mode and what is gained or lost in this choice? And what of the qualitative methods themselves? Will the traditionally separate methods of interview, observation and document analysis become blurred in online settings? If an interview is conducted in a chat mode, is it a document to be analyzed or an interview? Clearly we cannot answer all of these questions in any complete way here, we raise them as serious considerations for those engaged in qualitative research among online populations as well as for those who supervise students who wish to pursue qualitative inquiry projects in online education.

Qualitative Research Epistemological Viewpoints

Qualitative research is conducted in an effort to understand the experiences and attitudes of people in contextually bound settings. Purposes of qualitative research include inquiry in natural rather than contrived settings and the understanding the ontological viewpoints of the participants. Perspective, perception and experience are epistemological notions that are sought in the interpretation and understanding of specific contexts or situations. Because we wish to understand perceptions, experiences, and perspectives of learners in online environments, there is a viable match between qualitative inquiry and online learning environments. However, online qualitative inquiry methodology has not been clearly delineated or explicated nor is it definitively prescribed in the qualitative inquiry literature. In some ways we have gotten ahead of ourselves. We are using qualitative inquiry because it appears to be an epistemological match with our goals for understanding online learning environments prior to truly exploring the impacts of this application on the field of qualitative inquiry and the underlying epistemological foundations on which that discipline is built.

The discussion that follows is an overview of the three most common qualitative data collection methods (interviewing, observations, and document analysis) and their relevance to the understanding of online learning environments. We explore some of the implications of using qualitative *methods* and base these implications on our own experiences conducting qualitative studies in online environments.

Qualitative Methodology

Interviewing

Interviews and observations are used as key methods of recording people's experiences, perceptions and attitudes in qualitative inquiry. (Creswell, 1998). Interviews range in type and length and are used for different purposes but are present in virtually all qualitative traditions. Interviewees are often selected utilizing purposeful sampling processes and are contacted in many different ways. Telephone interviews are conducted when access to participants in a face-to-face environment are hindered in some way. (Bruce, 1979; de Leeuw, 1992). Telephone interviews carry the advantage that the participant can be interviewed at a remote location saving travel time and money, but the researcher loses the opportunity to observe nonverbal communicative actions. Focus group interviews are used in situations where the interaction among participants is determined to be beneficial for the inquiry. Ideal interview situations are personal, face-to-face contexts where the interviewer and the interviewee have the opportunity to interact in an open atmosphere and establish rapport (Fontana & Frey, 1994). Typically, qualitative interviews are recorded either by audio or video and are transcribed for the analysis of data. There are a number of ways of approaching interviews from open-ended to highly structured interview protocols.

Computer-mediated interviewing (CMI) techniques add quite another dimension. Media utilized to conducte CMI's include synchronous chat, email and discussion forums. As with telephone interviews, in CMI, face-to-face contact is lost. Voice tone and inflection, hesitation or eagerness, and other audible indications that lead to deeper understandings that are not possible through CMI are lost. While not without benefit, interviews conducted via chat may arouse questions regarding the conveyance of meaning since voice and body language are absent. On the other hand, little is left unquestioned in terms of specific data because it is necessary to ask for continual clarification from the participant throughout the CMI.

Face-to-Face	Telephone	Computer-mediated
Visibility of facial expressions	Absence of facial expressions and body language	Absence of facial expressions and body language
Personal qualities of establishing rapport with the participant	Voice tone assistance in establishing rapport	Absence of personal contact to aid in establishing relationship with participant(s).
Communication is more natural to most people in conversation form	Conversational tones are possible	
Travel time required	Travel time saved	Travel time saved
Transciption costs incurred	Transcription costs incurred	Transcription costs saved
Travel costs incurred	Telephone costs may be	Typically no or low cost

	incurred depending on type of long distance utilized	via internet hookup
Opportunities for on-site experiences are preserved	Opportunities for on-site experiences lost	Opportunities for on-site experiences lost
Ability to interview a limited number of respondents	Ability to interview more respondents	Ability to interview many respondents including those abroad, disabled, elderly, housebound

Table 1: Comparison of interview data collection modalities

It is possible to see from Table 1 a comparison of the advantages and disadvantages of the three possible media for conducting qualitative interviews. Obviously the primary advantage of using the telephone or the CMI options are resource related, e.g., time and money to travel to remote sites. However, there is no clear indication of precisely how much is lost in terms of the deep understanding of the stories being told by the respondents by losing their affective, interpersonal, voice and body reactions to questions. It is not clear how much data may be lost by the very different type of rapport that is established online or by telephone and it is almost impossible to quantify or qualify this loss because qualitative data is so individualized that there is no easy comparison study that can be conducted to establish what is truly lost and/or gained in these three environments. We believe that these decisions are likely to be made too often because of cost considerations. Rather than seeking additional resources to allow the researcher to be in the natural setting, thc breadth of respondents will be valued and the choices will be made to utilize cheaper methods than traveling to the site. It is the same principle as we use in the assignation of media in instruction. We ought not use a media merely because it is available, new, or glitzy--or well funded, but rather because it is what is called for in the instructional design based on the assessment, strategy selection, goals and objectives for the learner. In this same way, we should select telephone or CMI options for collecting qualitative data *because it is supported by the research question.* Methodological choices should not be made for financial reasons alone any more than they should be made for convenience reasons alone--thus the negative perception of samples of convenience studies. Instead we should allow our research question to drive our interview method choices among face-to-face, telephone, and CMI.

Observations

Qualitative observations (Adler & Adler, 1994) elicit some of the same issues as interviews, but the concerns here are even more pronounced. How is it possible to "observe" an online class? We know what it means to observe a face-to-face classroom, and we know how to design an observation instrument to assist us in focusing on the proper interactions, experiences, cultures, and environmental cues. However, we don't know what any of this means in the online environment. Do we observe individuals at their machines in their home space? Do we observe the class as it interacts online? Is the electronic space the actual classroom? What sorts of things are we looking for, what type of instrument will help us to focus on those things? Participant observations where the researcher is part of the culture in which the observation is being conducted, as is the case with ethnographic studies, leave the role of the researcher even more undefined in online environments. It is important to consider the practical as well as the theoretical and philosophical aspects of participant observations in online class settings.

In our experiences this is perhaps one of the most difficult things to handle in online learning environment inquiry. Because we do have certain "scripts" (mental or physical) which guide our interview protocols, the interview procedures are still somewhat familiar to us in electronic media. Although the social nature of the interview is significantly altered, the pragmatics of how to go about it are still relatively similar--that is to set out as series of questions (structured, unstructured, semi-structured) and begin conversing with respondents. But how do we go about really observing the online learning environment? Is it even possible? Here is an even more evident exposure of the social nature of qualitative inquiry (Wolcott, 1995). Here we have a real rub, what sort of observational techniques should we use, can we rely on the old checklists for observations that we had used traditionally? Do we have to shift foci in the same ways that we do in traditional settings? Unfortunately, our experience raised more questions than answers in this regard. We attempted to "observe" online settings by reading through the ongoing synchronous exchanges such as chats and asynchronous discussion forum communication. In

the end, our experience was so limited in this regard, that there is little we can really say by way of overall impressions or guidance. Rather we can merely raise these questions for careful --even cautious-- consideration by those embarking in online learning environment inquiry.

Document Analysis

Document analysis (Hodder, 1994) is perhaps the least difficult qualitative data issue to be resolved. Since there are fewer abstractions that are important (e.g., voice tone, culture of a classroom, etc.) in document analysis, the issues are a little less complicated. Clearly online course materials as with face-to-face course materials are prime candidates for document analysis in such studies. In the same way, student materials are also documents. But in the online environment, there are typically many more "printed" resources than there may be in the face-to-face environment. What is to be considered a document? Is the chat that the students conduct on regular Monday meeting times, for example, to be considered documentary, observation, or interview data? Documents typically included in qualitative research for data analysis appear in the form of written text. Written text assumes a purpose depending on the author and the intended use of the document. Creswell (1998) distinguishes between texts written as records of information, i.e., public documents, reports, contracts and others such as diaries or journals, written for personal use. Journals, logs and diaries are sometimes requested by the researcher as a way for participants to keep track of and reflect on their activities in a particular situation or context.

In online learning environments, information is presented in the form of written text in several aspects including (but not limited to) synchronous chat, discussion forum, project submissions, email communication and written reports or summaries. As these class activities are utilized in ways that intend to mirror activities typically integral to face-to-face learning environments, in which case they would not be considered in document analysis, but rather as observation or interview data. In what ways does this change the nature of data collected. In the case of document analysis, wherever this cautious distinction is drawn and there is care to maintain authenticity in the documents themselves, it is likely that, in this one area, there is the least impact of the switch from face-to-face to online inquiry subject. This is primarily because there is inherently less "socialness" to the procedures within most document analyses even within the qualitative tradition. It is more anthropological in nature, uncovering the cultures and understandings of authors as a result of careful dissection of documented data.

Conclusion and a Note of Caution

With the growing interest in online education and the vast difference in teaching and learning between online and face-to-face learning environments, it is becoming more and more necessary to gain a better understanding of the experiences students face in new distance education endeavors of many institutions of higher education. While there is little research available in this area, we believe qualitative methods in seeking this information, are not only appropriate but necessary in developing a greater understanding of student experiences. However, the employ of qualitative methods founded on assumptions of the social nature of inquiry can only be used with great caution. It is essential that as we continue to examine online learning environments in qualitative ways that we carefully reflect on the experience of doing online interviews, online observations and electronic document analysis and try to capture how we see these experiences as differing from previous experiences in qualitative research.

It is essential that all good qualitative research have certain hallmarks of quality, and in one final note, we wish to emphasize the importance of disclosing one's researcher identity. Even more so than in many other areas, the online revolution has recently turned into an online opinion war with many folks lining up on both sides, pro (Dede, 1997) and con (Noble, 1998). Because the online learning craze is likely to affect our own lives and livelihoods, it is essential that we are clear with all readers of precisely our own feelings and biases with regard to this new innovation in honest, up front ways.

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A Model for the Efficacious Use of Sound in Multimedia Instruction

Mary Jean Bishop
Ward Mitchell Cates
Lehigh University

Abstract

Recent technological advances now make possible full integration of sound in instructional software. This paper explores the systematic use of sound to enhance learning. It illustrates a model of the "instructional communication system" based on a combination of information-processing and communication theories. The model identifies and characterizes the way sound might be used to optimize learning from multimedia instruction.

Technological and cost barriers to full integration of sound in instructional software have recently disappeared. Conceptual and preconceptual barriers, however, still appear to prevent software designers from using sound more effectively in their instructional products. Interface books seldom discuss the use of sound, and when they do, the use most often discussed is simple verbatim narration of on-screen text (see Bickford, 1997; Cooper, 1995; Galitz, 1997; Mandel, 1997). Because most "classics" of instructional interface design were written before sound was a viable design component, sound is seldom well discussed (see Alessi & Trolip, 1985, 1991; Hannafin & Peck, 1988; Jonassen, 1988; Keller, 1987). In general, interface design guidelines identify three main uses of sound in instructional software: to alert learners to errors, to provide stand-alone examples (like musical passages or digitized versions of speeches), or to narrate text on the screen (for redundant presentation, for non-readers, or for those with auditory limitations). Review of research on sound in instructional software reveals a focus on the third use cited above, digitized or computer-generated synthetic speech narration (see Barron & Atkins, 1994; Mann, 1995; Shih & Alessi, 1996). While some outside education have considered non-speech interface sounds (Blattner, Sumikawa, & Greenberg, 1989; Gaver, 1986), many promising uses remain unexplored.

Before one can determine sound's potential contribution to instructional software, however, one must have a clear picture of the component processes involved in learning. Therefore, this paper begins by exploring the operations and limiting factors of information-processing.

Information-processing Operations and Limiting Factors

According to information-processing theory, learning emerges from processing interactions among information from the environment and the learner's knowledge and previous experiences. Most theorists have adopted at least the basic structure of the three-stage memory model first proposed by Atkinson and Shiffrin in 1968.

The Atkinson-Shiffrin Information-processing Model

In the Atkinson-Shiffrin model, environmental stimuli in their primitive form are first handled by a sensory information store, or *sensory register*. Signals held here are readily displaced by subsequent signals in the same sensory channel. The sensory register filters and then routes incoming signals to a second, *short-term store* where information is held temporarily until it can be encoded for storage. *Encoding* is the process of building relationships and connections within new material or between new material and existing knowledge structures. Once encoded, the information is moved into *long-term store* in the form of *images* (the autobiographical knowledge or *episodic memories* one has for things that have been personally experienced) or *schemas* (the organized, propositional knowledge one has for the meanings, rules, and algorithms used to manipulate and understand the many symbol systems encountered in life) (Tulving, 1972). Long-term store is both the place where we hold newly encoded information and the place from which we retrieve well-established memories. Recovering information from long-term store requires *cues* that may be supplied externally by the situation or internally by one's existing memories. These cues are used to search long-term store in order to identify and retrieve matches. *Control processes* "oversee" the cognitive system by regulating the exchange of information between the sensory register and long-term store, determining which search-and-retrieval strategies to use to access information from long-term store, and deciding when sufficient information has been retrieved.

Information-processing theorists maintain that learning occurs when information that has been transferred to and stored in long-term memory can be retrieved when needed. Transforming incoming environmental stimuli into learned images and schema involves three main operations: acquisition, processing, and retrieval. It appears, however, that limitations in each of these operations may restrict the amount of data one can store long-term.

Limiting Factors in Information Processing

In order to acquire or make sense of the constant barrage of sensory information, an individual must decide, often unconsciously, which information to attend to and which to ignore. To explain this phenomenon, Broadbent (1958) posited that all information reaching the sensory register is subjected simultaneously, or in parallel, to a preliminary analysis based on prior knowledge. From this pre-perceptual analysis of the entire sensory scene, one chooses a smaller subset of stimuli to process successively, or in serial, through the rest of the cognitive system. The "bottleneck" created between parallel pre-perceptual and serial perceptual stages restricts the amount of information entering the cognitive system. Individuals remain essentially unaware of information not selected for attention.

Like many later researchers, Wundt (1896/1897) found short-term store is also of limited capacity: There is a limit to the amount of information, or maximal *cognitive load*, an individual can process in short-term store at any given time. Although it may be that cognitive load varies somewhat, depending upon the nature of input stimuli, our capacity for processing incoming data is certainly limited to some finite quantity. Information that exceeds cognitive processing capacity is dropped from short-term store without being processed. Further, unless information that enters the store is rehearsed, it decays within approximately five to twenty seconds. Short-term store limitations dictate that data not encoded and moved into long-term store must be overwritten to make room for new incoming stimuli (as when we forget a new phone number after hearing another series of numbers) or consciously rehearsed and then discarded immediately after use (as when we repeat a telephone number aloud until we have dialed it).

Memories often seem to fade with the passage of time. Forgetting is a failure to retrieve information from long-term store. There are three general hypotheses about the factors that cause forgetting, each of which probably contributes to overall retrieval problems. The decay hypothesis asserts that the strength of a memory simply weakens over time and therefore is harder to retrieve (Wickelgren, 1976). The interference hypothesis claims that competition among memories blocks the retrieval of a target memory (Postman, 1961). The retrieval-cue hypothesis asserts that at the time of retrieval we lose access to the internal "indices" that point to the memory's location in long-term store (Norman, 1982). There is some evidence to suggest that once information has been moved to long-term store, it remains there forever (Nelson, 1971). While this means memories may never actually leave long-term store, individuals certainly can lose access to them.

Berlo (1960) suggested that the study of learning processes and the study of communication processes differ only in their point of view. While learning models generally begin with and focus on how messages are received and processed by learners, communication models most often begin with and focus on how messages are sent. Learning from instructional software, therefore, might be viewed as an *instructional communication system* with a set of interrelated parts working together to produce learning (Banathy, 1996).

Communication Operations and Limitations

Communication is the transmission, reception, and decoding of signals. As was the case with information-processing theory, one model —Shannon and Weaver's *The Mathematical Theory of Communication* (1949/1969)— appears to have been particularly influential in shaping communication theory.

The Shannon-Weaver Communication Model

The Shannon-Weaver model proposes that all communication processes begin when a *source*, desiring to produce some outcome, chooses a message to be communicated. The message is encoded to produce a signal appropriate for transmission over the *channel* that will be used. After the message has been transmitted, a *receiver* then decodes the message from the signal transmitted. All channels have limited capacity. In humans, *channel capacity* generally refers to the physiological and psychological limitations on the number of symbols or stimuli that individuals can process. When more symbols are transmitted than a channel can handle, some information is lost.

According to Shannon and Weaver, communication is "perfect" when the information contained in a message affects the receiver in exactly the way intended by the source. Communication is rarely perfect, however; at any point things can get added to the signal that were not originally intended by the source. This spurious information, or *noise*, introduces errors that increase the uncertainty in the situation and make the signal harder for the receiver to reconstruct accurately.

Limiting Factors in Communication

Shannon and Weaver divided the analysis of communication problems into three levels. "Level A" deals with how accurately the signal is received. When competing external or internal stimuli exist in a communication channel, the resulting noise introduces technical errors that can overpower all or part of a signal transmission. This disruption prevents the receiver from being able to select the communicated signal for decoding. No matter how accurately a message is transmitted, however, if it cannot be decoded by the receiver it is not likely to convey the

intended message. "Level B," therefore, concerns how precisely the received signal conveys the intended message. Decoding requires the receiver to analyze an incoming signal based on his or her existing schemas. When no interpretive framework exists and none is supplied by the source, the resulting noise introduces semantic errors that prevent the signal from conveying the intended message. Even when a message is interpreted correctly, it still may not accomplish the source's goal. Thus, "Level C" involves whether the received message ultimately produces the outcome desired by the source. To effect an outcome, the elements and structure of the message that assign connotative meaning —such as aesthetic appeal, style, execution, and other psychological and emotional factors— must mesh with the receiver's own relevant beliefs, cultural values, and experiences. If this synthesis leads the receiver to make inferences about the message that are not intended by its source, the resulting noise introduces conceptual errors that can prevent the communication from producing the desired result.

Although Shannon and Weaver confined their work primarily to the study of Level A problems of mechanistic communication systems, they contended that improving the effectiveness and efficiency of the communication process overall requires applying concepts from their model to all three levels of communication problems. Their work suggested that there may be ways to anticipate communication difficulties and "front load" messages with the cues necessary to "squelch" noise even before it occurs.

Using Sound to Squelch Noise in Instructional Communication Systems

Sounds can support learning in a variety of ways. They can gain and focus learners' attention, reducing the distraction of competing stimuli, engaging interest over time, and making environments more tangible and emotionally arousing (Kohfeld, 1971; Bernstein, Clark, & Edelstein, 1969; Thomas & Johnston, 1984). They can help learners condense, elaborate upon, and organize details about their surroundings, helping them to see interconnections among new pieces of information (McAdams, 1993; Winn, 1993; Yost, 1993). They can provide a familiar setting that may help learners relate incoming information to existing knowledge (Deutsch, 1980, 1986; Gaver, 1993). Thus, McAdams and Bigand (1993) argued that sound is uniquely suited to assist in the acquisition, processing, and retrieval of new information for those who are not hearing-impaired. If this is true, there may be systematic ways to design *multi-cue* instructional messages that overcome information-processing noise and optimize learning.

The Role of Multi-cue Messages in Instructional Communication Systems

For some time it has been thought that simply adding cues to messages might improve the effectiveness of instructional communication. The idea behind *cue summation* is that the more cues used, whether within or across sensory channels, the greater the amount of information communicated and the more learning gained. While the results of cue summation studies appear contradictory on the surface, Severin (1967) maintained the differences might be explained by the degree of redundancy among cues used in the treatments. Severin noted that studies that found no difference between multiple-cue and single-cue communication used cues that were almost totally redundant, such as text coupled with word-for-word narration. In these studies the wedded cues apparently neither competed with each other nor supplied new information. In contrast, studies that found multiple-cue communications less effective than single-cue communications used cues with no redundancy between them, such as text coupled with unrelated speech. In these studies, the dueling cues probably exceeded channel capacity, producing noise that decreased communication efficiency. Severin concluded that studies that found multi-cue communications to be more effective than single-cue communications used cues that were partially redundant, like pictures coupled with related narration. In these studies, primary and secondary cues appear offset just enough for the secondary cue to supply the right balance of redundancy and new information. Severin contended that multi-cue messages can be designed to help improve instructional communication. The question is not just whether the message contains multiple cues, but whether those secondary cues supply the optimal amount of redundancy.

The Role of Redundancy in Instructional Communication Systems

Redundancy is the information message cues share: the parts that "overlap." For example, a source might attempt to correct technical problems in the system (Level A) by retransmitting or amplifying the signal. This content redundancy often can help overcome transmission errors by completing obstructed signals or by preventing the interference in the first place. A source anticipating semantic problems in the system (Level B) might attempt to correct them by supplying the relevant connections between and among related message signals. This context redundancy often can help overcome misinterpretations by furnishing denotative meanings for signals. A source might attempt to correct conceptual problems in the system (Level C) by carefully choosing signals that make appropriate links to receivers' preexisting concepts in memory. This construct redundancy clarifies the connotative meanings behind message signals and reduces misunderstandings.

When a source anticipates noise at the various levels of communication, the trick may be in knowing how much and which sort of between-cue message redundancy to include in order to counteract noise. Striking this optimal balance may also be the key to successful instructional communication. Further, it appears that multi-cue

instructional messages incorporating sound might both deliver sufficient amounts of new information and supply the noise-defeating content, context, and construct redundancy necessary to enhance learning. Theories of system optimization, such as that presented by Wilde and Beightler (1967), recommend creating a model of the system in order to understand precisely what the system must do to accomplish its goal. This model might then serve as a frame of reference for subsequent evaluation of the system.

Modeling the Instructional Communication System

Understanding the underlying component processes of instructional communication might begin by adding the receiver's information-processing transactions to the Shannon-Weaver model. Figure 1 depicts the receivers' component processes in more detail, illustrating an idealized representation of the three levels of communication as three learning *phases* (select, analyze, and synthesize) and depicting instructional communication limitations — channel capacity and noise— as constraints on the system.

If we were trying to discover only what output the system produces for a given mixture and amount of input, this "black box" model might be adequate. However, our concern here is to determine what amounts and mixtures of input at each phase of learning will bring about the kinds of system activity necessary to produce optimal learning output (Churchman, 1968). In order for us to understand how input might affect instructional communication, the model must approximate more closely the complex circles of influence that exist among the proposed learning phases, the system's component information-processing operations, and the human-communication system constraints. Figure 1 neither depicts the role that acquisition, processing, and retrieval operations play in each learning phase nor suggests how the system might utilize the content, context, and construct redundancy in an instructional message to help the receiver overcome system constraints.

In order to explore the area inside the boxes, it might be useful to move from the traditional flow-chart type of diagram toward a structural illustration that approximates more closely the more dynamic nature of the instructional communication system. The model illustrated in Figure 2 and in subsequent figures in this chapter

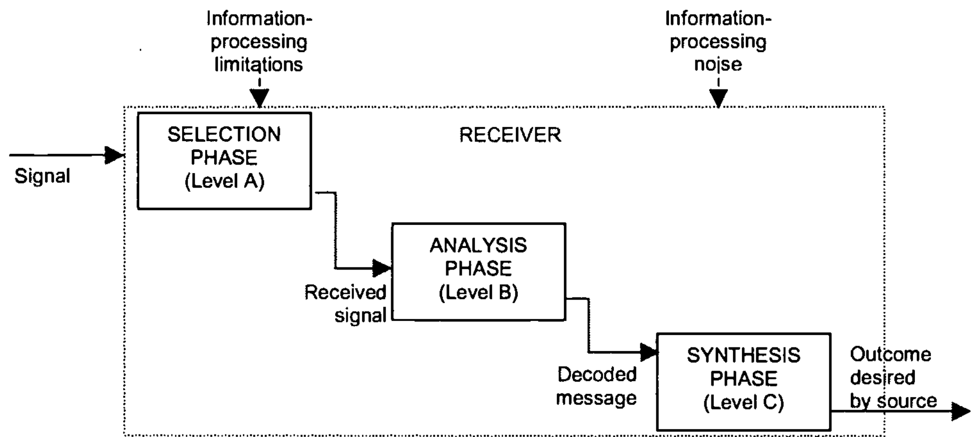

Figure 1. Idealized information-processing explanation for receiver learning transactions.

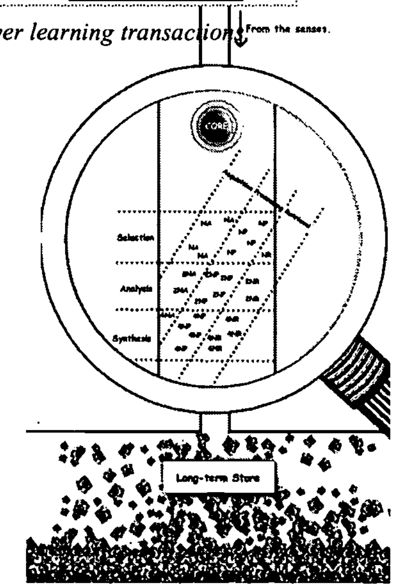

Figure 2. A representational illustration of the instructional communication system.

draws parallels between the instructional communication system and the process of crystal formation in chemistry.

Thus, Figure 2 eliminates the traditional boxes and arrows in favor of a grid of intersecting lines that represents learning phases and operations as an instructional message moves through the instructional communication channel. The

channel is drawn as the area between two parallel lines running vertically from the top to the bottom of the diagram. The message is represented as a set of increasingly lighter concentric circles (moving from inner *core* to outer circle). The areas between the lines running horizontally from left to right represent the three transactions or "phases" of learning —selection, analysis, and synthesis— identified for use in the earlier, linear model. This is the learner's working memory. The areas between the channel lines running diagonally (from lower-left to upper-right) represent the three information-processing operations that the receiver uses at each phase of learning in order to process the instructional signal.

The dividing lines between acquisition, processing, and retrieval dissect the channel diagonally in order to illustrate how each operation is applied in varying amounts at each learning phase. Processing is depicted as the middle of the three because it relies on acquisition and retrieval to supply the information and memories it acts upon. During selection, processing calls upon acquisition heavily; in contrast, only the most salient memories are retrieved during selection. During analysis, processing is central —although acquisition and retrieval are also relatively active. During synthesis, processing calls upon retrieval most heavily, while only the most salient new stimuli are acquired.

The area at the bottom of the model represents long-term store, with its schema particles "suspended" and "fluid." These schemas are retrieved from memory to help learners make sense of new information. The particles in the long-term store suspension are not disordered; related crystals naturally gravitate toward one another and may align to form more complex and interdependent structures. The extent to which particles remain suspended and fluid, however, depends upon how often they are "agitated." Particles that have just recently been stored or retrieved from memory waft to the top of long-term store, carrying others around them along in their wake. This activity makes these memories easily accessible to working memory and likely to be among the first retrieved in later learning situations (Norman, 1982). Schema particles suspended in long-term memory will settle slowly if left stagnate. Unless schemas occasionally are retrieved from long-term store and the "silt" stirred up, they become too deeply embedded and are forgotten. Stagnate memories lack the fluidity to be applied to new learning situations.

Because of the inevitable differences among learners' characteristic cognitive, conative, and affective traits, the instructional communication channel is always prone to noise (Corno & Snow, 1986). For example, the same instructional method that gains one learner's attention may not gain another's (Biehler & Snowman, 1982). Some learners will lack the prior knowledge they need to help them make sense of the new information (Rumelhart & Norman, 1981). Still other learners may be unable or unwilling to apply their knowledge mindfully when appropriate (Langer, 1989). The potential for acquisition, processing, and retrieval noise in the selection phase is depicted in Figure 3 as "NA," "NP," and "NR," respectively. (Despite possible similarities between the letter code representations used in the model and the names of actual chemical elements, such letter codes here do not represent such elements.)

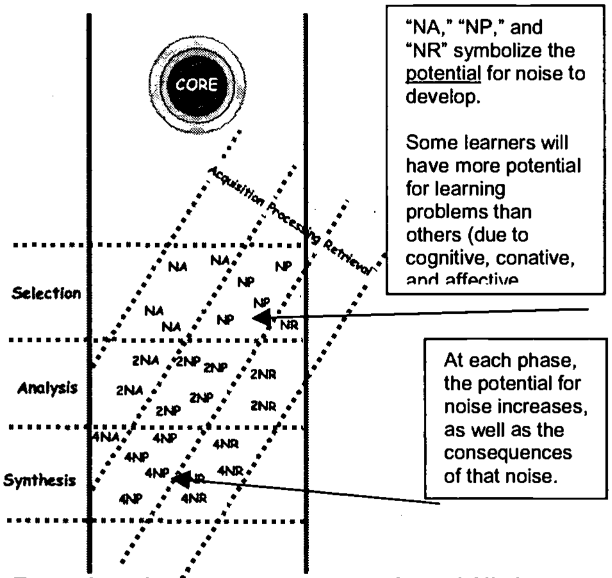

Figure 3. Redundant message enters channel filled with the potential for developing noise.

At each deeper phase of learning, the relative "strength" of potential noise as well as the ultimate consequences of that noise increase by some factor. For example, while it can be difficult to overcome acquisition noise at selection in order to gain a learner's attention, it often is much harder to overcome acquisition noise in analysis in order to focus a learner's attention, and harder still to hold a learner's attention over time for synthesis. While there is no way to know the actual

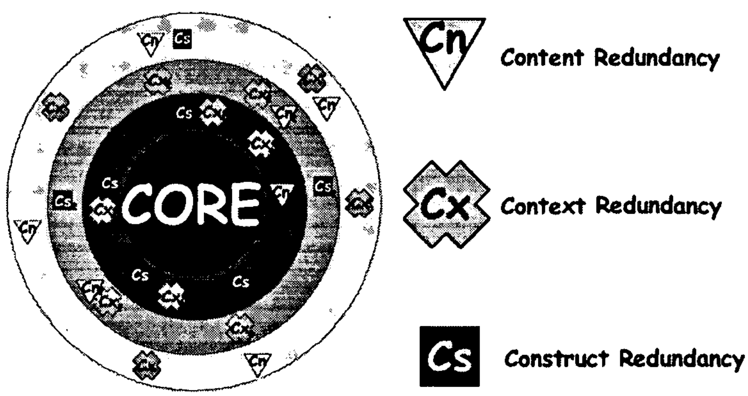

Figure 4. Message contains three layers of "solute" with varying amounts of content, context, and construct redundancy "molecules."

proportions/concentrations of noise at each phase, for purposes of illustration, the authors depicted the potential for acquisition, processing, and retrieval noise as "NA," "NP," and "NR" in the selection phase, "2NA," "2NP," and "2NR" in the analysis phase and as "4NA," "4NP," and "4NR" in the synthesis phase. Similarly, because the proportion of acquisition, processing, and retrieval noise potential is likely to be closely related to the proportion of acquisition, processing, and retrieval involved at each learning phase, acquisition noise potential at selection is depicted using 4 "units" as compared with 1 "unit" of acquisition noise potential at synthesis. Conversely, retrieval at selection is depicted as fairly low (1 "unit") whereas it is comparatively high at synthesis (4 "units"). The potential for processing noise remains the same at each learning phase (4 "units").

Figure 4 supplies a closer look at the instructional message. The black circle labeled "CORE" represents the entropic, core knowledge that the instructional message is intended to convey. The increasingly lighter circles around the core (moving from inside to outside) represent its layers of redundancy that have been "formulated" for each learning phase. Figure 6 depicts the ratio of content, context, and construct redundancy "molecules" that would be appropriate for the learning situation depicted in Figure 3. That means the number of redundancy molecules within each ring are balanced for the information-processing needs of its intended learning phase and the potential for channel noise given the audience and the content. Recall, however, that the proportions/concentrations used here are merely for illustration.

As depicted in Figure 5, when an instructional message enters the selection phase of working memory its first layer of redundancy dissolves. Depending upon the learner's ability or willingness to exert information-

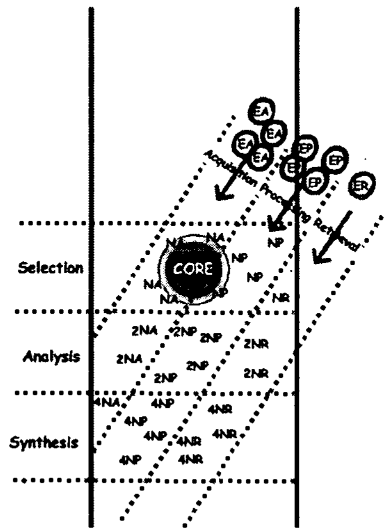

Figure 5. First redundancy layer dissolves stimulating selection-level information-processing.

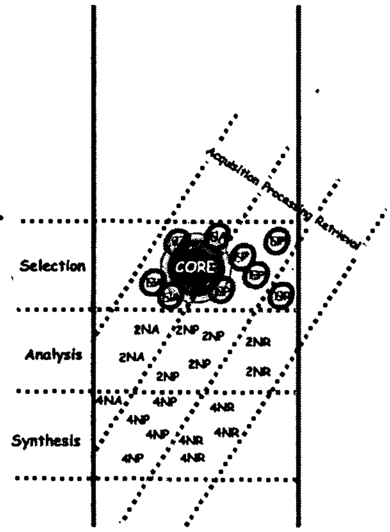

Figure 6. Information-processing effort "reacts" with potential noise and the redundancy in the message.

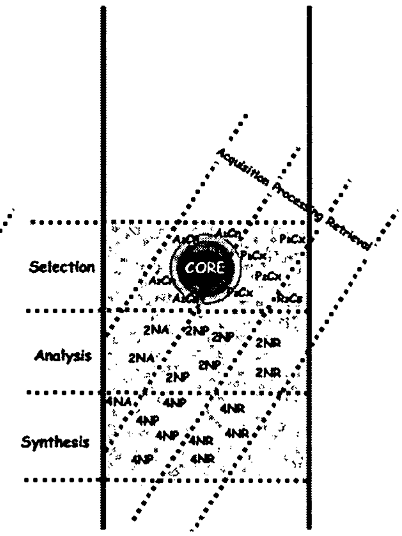

Figure 7. Noise potential is "neutralized."

processing effort, the content, context, and construct *solute* stimulates the production of acquisition, processing, and retrieval *ions* ("EA," "EP," and "ER," respectively). When these ions are added to a *solution* that already contains redundancy dissolved from the message (Cn, Cx, and Cs), and various forms of information-processing noise potential (NA, NP, and NR), three "chemical reactions" occur (Figure 6). These reactions theoretically could be depicted mathematically:

$$NA + Cn + EA \rightarrow A_2Cn + NE$$
$$NP + Cx + EP \rightarrow P_2Cx + NE$$
$$NR + Cs + ER \rightarrow R_2Cs + NE$$

The first formula means that when the potential for acquisition noise is combined with content redundancy and the learner's effort to acquire the material, the resulting products are gained attention (A_2Cn) and residual positive affects of learning, such as improved attitudes and feelings of success, that serve as *catalysts* for continued learning(NE, as in "noise + energy"). The second formula indicates that when the potential for processing noise is combined with context redundancy and the learner's effort to process the material, the resulting products are isolated relevant stimuli (P_2Cx) and more *positive residual* (NE). The third formula indicates that when the potential for retrieval noise is combined with construct redundancy and the learner's effort to retrieve schemas from long-term store, the resulting products are retrieval of the appropriate constructs from memory (P_2Cx) and still more NE. The final outcome of successful selection-level processing is depicted in Figure 7. At this point in the instructional communication system, the learner is interested in the message and has selected it for further processing. Further, higher concentrations of NE make the working memory solution thicker, slowing the message and allowing deeper processing.

Similar reactions occur in the analysis phase. Once again, using our hypothetical proportions/concentrations, the analysis reactions might be depicted like this:

$$2NA + Cn_2 + EA \rightarrow A_4Cn_2 + 2NE$$
$$2NP + Cx_2 + EP \rightarrow P_4Cx_2 + 2NE$$
$$2NR + Cs_2 + ER \rightarrow R_4Cs_2 + 2NE$$

Analysis-level reactions yield focused attention (A_4Cn_2), information organizing and categorizing (P_4Cx_2), efforts to build upon existing knowledge (R_4Cs_2) and even higher levels of positive residual (2NE). At this point in the instructional communication system, the learner is curious about the message and is actively analyzing its meaning. Further, higher concentrations of NE continue to make the working memory solution thicker and decrease message speed.

Finally, the synthesis reactions employing our hypothetical proportions/ concentrations, might look like this:

$$4NA + Cn_4 + 4EA \rightarrow A_8Cn_4 + 4NE$$
$$4NP + Cx_4 + 4EP \rightarrow P_8Cx_4 + 4NE$$
$$4NR + Cs_4 + 4ER \rightarrow R_8Cs_4 + 4NE$$

The product of synthesis-level reactions is attention held over time (A_8Cn_4), elaboration upon the new information (P_8Cx_4), construction of more transferable knowledge structures (R_8Cs_4), and still higher levels of positive residual (2NE). At this point in the instructional communication system, the learner is engaged in the message and is affected by its larger meaning. Still higher concentrations of NE continue to "thicken" the solute and slow the message's passage through the system, fostering deeper processing.

Thus, as each layer of carefully chosen redundant material dissolves, the message "solute" acts to "neutralize" the acquisition, processing, and retrieval noise in that phase. In Figures 5-7, the first layer of redundancy dissolves into the learning "solution" and, with the learner's help, the solute counterbalances errors caused by acquisition, processing, and retrieval noise in the selection phase. Here, the instructional signal provides redundant message cues aimed primarily at helping the learner **select** the instructional signal. Similarly, the second layer of redundancy in an instructional message can reduce the effects of acquisition, processing, and retrieval noise in the analysis phase when the learner exerts information-processing effort. Now, the instructional signal includes message cues intended to help the learner **analyze** the message. In the final phase, the third layer of message redundancy, in conjunction with even greater information-processing effort on behalf of the learner, neutralizes acquisition, processing, and noise at the synthesis phase. Here, the instructional message includes cues that help the learner to **synthesize** the content of a message.

By the time the message has reached the synthesis phase, all redundant layers have dissolved and the learning "solution" has reached its *saturation point*. Meanwhile, the learner ideally has become a more motivated participant in the learning (NE) and is thinking deeply about the material. This state of engagement thickens the saturated learning solution and slows the message to a stop. These conditions, when they exist, set the stage for the core knowledge to *seed* the development of a crystallized schema. Figures 8, 9, and 10 illustrate how the message held in synthesis —now dissolved down to its core knowledge— "crystallizes" into a schema in the enriched solution. During synthesis, learners draw upon the acquired content, processed contexts, and retrieved constructs that are the products of the chemical reactions at each learning phase. Learners use these materials to build and develop their own structures, or "crystallized" understandings of the core knowledge conveyed in the message. Like crystals, no two schemas are alike; each schema formed will be unique to the learner. Thus, as the message moves through the learning phases, it is processed more deeply until it forms a new schema. That schema is then passed on to long-term storage.

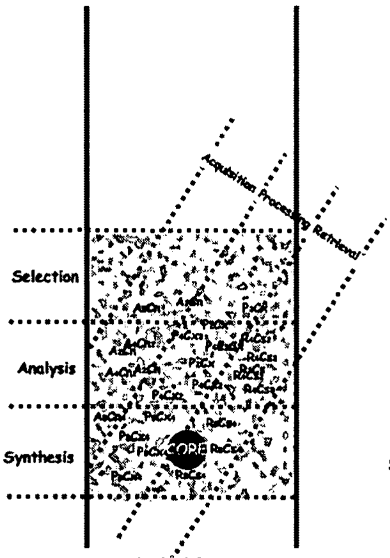

Figure 8. While held in synthesis, the core begins to attract solute from saturated solution.

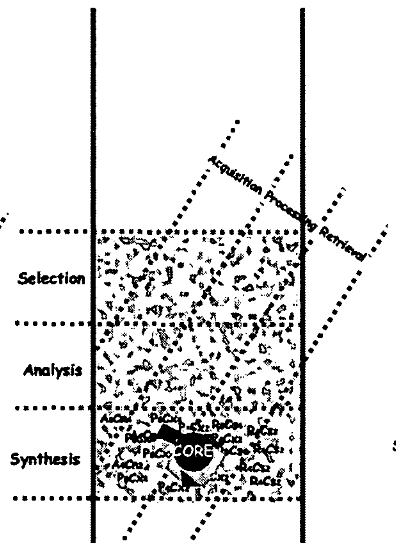

Figure 9. Schema grows, pulling together surrounding elements in the channel.

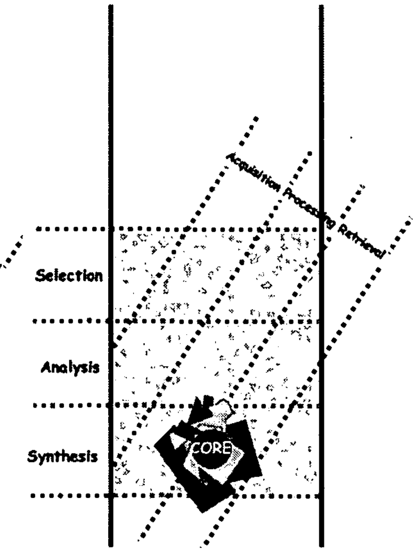

Figure 10. A schema, unique to the learner, is formed, leaving behind some of the positive affects of learning (NE).

When a message with very little redundancy enters the system, it is likely to run into instructional communication problems at each learning phase. Messages with insufficient selection-level content, context, and construct redundancy do not evoke enough information-processing effort from the learner to overcome all of the potential for noise. Likewise, these "chemical reactions" produce very little positive residual (NE) to slow message transit. As the accelerating message reaches the analysis phase, the little analysis-level redundancy it contains fails to neutralize still more noise potential and doesn't slow the message down for deeper processing. By the time the message speeds through synthesis, its lack of redundancy has left noise potential behind in each learning phase.

While it is possible for the learner to defeat some of the noise potential and slow the message for deeper processing without the aid of redundancy, the chemical reaction "formulas" suggest that this will likely require that the learner supply more than just self-motivated information-processing effort. In order to yield sufficient amounts of positive residual to slow the message, the learner will probably also have "fill in" the Cn, Cx, and Cs parts of the equation with dedicated attention, preexisting strategies for processing the new information, and prior understandings of the topic. Further, if any channel noise potential is not overcome during processing, it

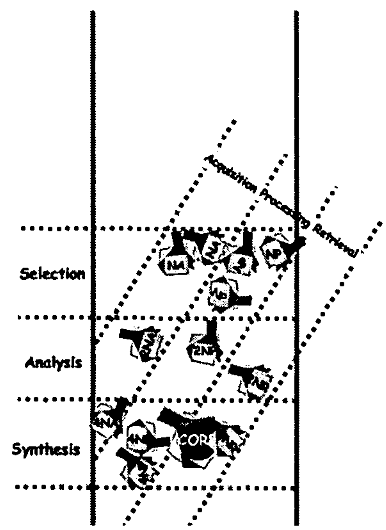

Figure 11. Even if the core remains in the channel long enough to crystallize, potential noise remaining in the channel may also act as "seeds," increasing the uncertainty in the situation.

will crystallize along with the core during synthesis, depriving the *message crystal* of needed solute. Ultimately, the errant structures increase the uncertainty in the situation, making it difficult for the learner to separate the deprived core knowledge structure from the noise (see Figure 11).

The more likely scenario, however, is that the weight and density of a message with very little redundancy will cause it to pass through the system unimpeded and largely unprocessed. If a learner is not interested in, curious about, or engaged by what dissolves from the message, he or she will not exert the information-processing effort that slows it down at each learning phase for deeper processing and reflection. While what's left of the message core may actually end up somewhere in long-term store, its mass and velocity mean that —if it can subsequently be located— it may well be buried too far out of reach to be easily retrieved.

Like message schemas, the noise that crystallizes in the channel eventually begins to make its way into long-term store, leaving behind even more potential for noise in subsequent learning. When noise structures (misinterpretations, misunderstandings) find their way into long-term store, they can be difficult to extract later. Instructional technologies that are not "front loaded" to subdue acquisition, processing, and retrieval noise are unlikely to produce outcomes that match their goals (Dick & Carey, 1990). Effective instructional designers recognize this problem and build into the message the redundancies needed to resolve those problems should they occur. Sound may play a role in such design. This model may help to illustrate that role by clarifying the operations and limiting factors within the instructional communication system.

A Cautionary Note: The Function of a Model

The model we propose is intended to help the reader conceptualize the role of redundancy in enhanced message transmission. Britt (1997) maintained that a model —through simplification, explicitness, and reformulation— provides an effective way to sort out the chaos of systems that are too complex to deal with directly. Because explicit systems models can show the repeating patterns and relationships among the parts, they can help one understand the true complexity of the problem or situation. Salisbury (1996) argued that to be useful, however, a model must represent all of the system's components and the relationships between them simply enough to be understandable. The model must reduce complexity and ambiguity sufficiently so as to make analysis and the prediction of system behavior possible. But simplifying real-world complexity poses a dilemma. If a model is too simplistic, the relationship of the model to its real-world counterpart becomes tenuous. When this occurs, predictions of system behavior based on the model can be grossly inaccurate. Thus, we cannot expect to model a system precisely. Modeling is not about precision but, instead, about tentatively determining which things are important to consider in capturing the essence of the system. A model cannot provide final answers. As knowledge is accumulated and relevant areas of the modeled system are clarified, the model is almost always modified.

We suggest that this model may prove useful in deciding how to incorporate message redundancy through the use of sound cues in instructional software. Before one can do that, however, the model's assumptions should be tested against what is known about "real world" instructional software. This should help to explicate the model and reveal more specific ways sound might be used to improve the effectiveness and efficiency of the instructional communication system.

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Preparing Teachers To Integrate Technology Using Constructionist Methodology: Don't Teach Me How I Know I Should Teach; Teach Me How I Want To Be Taught

J. M. Blocher
L. Sujo de Montes
G. Tucker
E. M. Willis
Northern Arizona University

Introduction

Currently, many educators suggest that learning can be enhanced if the learning environment includes more interactive, student-centered, and engaging activities where learners construct their understanding rather than more traditional methods of teacher-centered, direct instruction. Inherent is a paradigm shift from more historical teaching methods to an environment where teachers relinquish control and learners accept responsibility for learning. Many agree that this promotes more ownership and stimulates more meaningful learning. However, engaging in such a learning environment presents challenges for both the teacher, who designs, develops, and facilitates this complex environment, and learners who must interact and take responsibility for constructing their understanding.

This paper describes a study conducted by Northern Arizona University's Educational Technology faculty regarding training teachers for the integration of technology and the promotion of learner-centered instruction. Participants included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. Instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology. The learning environment was designed to provide introduction to skills and practice exercises utilizing computer applications that could be later used within their teaching practice.

Constructivist/Constructionist Approach

What is knowledge? How does one teach this knowledge to others? Looking at educational pedagogy from a very elementary approach, the way one answers the first question will determine how they approach the answer to the second. One can approach the answers from the standpoint that knowledge exists outside of the learner, there are fundamental truths and teaching is helping learners master them. If this is a person's view of knowledge, then teaching usually takes the form of direct instruction and the goals center around students acquiring and repeating factual information. Most printed textbooks are designed for, and many teachers are trained in, this model. Students usually read or are told factual information, and then repeat this information as a part of assessment. This model of knowledge, often referred to as the objectivist model, works well when the objectives to be met result in a type of informational memorization.

One can also view knowledge as something beyond a set of facts, or concepts, or laws that are to be memorized. One can possess a view of knowledge that incorporates an understanding of causes and effects involving ideas and actions that requires the use of higher-order or critical thinking skills. This view does not conceive knowledge as something that exists independent of a knower. Zahorik (1995, pp. 11-12) summarized this view of knowledge in the following way:

> "*Knowledge is constructed by humans*. Knowledge is not a set of facts, concepts, or laws waiting to be discovered. It is not something that exists independent of a knower. Humans create or construct knowledge as they attempt to bring meaning to their experience. Everything that we know, we have made.
> *Knowledge is conjectural and fallible*. Since knowledge is a construction of humans and humans are constantly undergoing new experiences, knowledge can never be stable. The understandings that we invent are always tentative and incomplete.
> *Knowledge grows through exposure*. Understanding becomes deeper and stronger if one tests it against new encounters."

This model of knowledge is often referred to as the constructivist model. Constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning. The constructivist model relies on cognitive psychology for much of its theoretical foundations and has roots in philosophy, sociology, and education. It is important to understand the implications this view of learning has for teaching. The Southwest Educational Development Laboratory News (SEDLetter) in August, 1996 stated:

> "First, teaching cannot be viewed as the transmission of knowledge from enlightened to unenlightened....
> Second, if learning is based on prior knowledge, then teachers must note that knowledge and provide learning environments that exploit inconsistencies between learners' current understandings and the new experiences before them....
> Third, if students must apply their current understandings in new situations in order to build new knowledge, then teachers must engage students in learning, bringing students' current understandings to the forefront. Teachers can ensure that learning experiences incorporate problems that are important to students, not those that are primarily important to teachers and the educational system....
> Fourth, if new knowledge is actively built, then time is needed to build it..."

In educational pedagogy, the reality of the situation is that, teachers find themselves in both the objectivist's camp and the constructivist's camp depending upon the learning objectives of the moment. There are times in our classrooms that our objectives are such that we are actively involved in the "transmission of knowledge from enlightened to unenlightened." There are others times that our learning objectives are such that we do our best to create situations where "students must apply their current understandings in new situations in order to build new knowledge." Teaching is often described as being an art. The art of becoming a master teacher can be seen as an awareness of when to be in one camp or the other and an understanding of how to be effective no matter what camp one is in.

In contemporary education, there has been added to this complexity of teaching and learning the concept of the integration of modern technology. For teachers who are at the moment in the objectivist's camp, technology becomes a tool for a more effective way of transmitting knowledge. In this context, the integration of technology usually takes the form of some type of PowerPoint® presentation or the use of some other multimedia presentation software to supplement teacher-centered instruction. But for those times when a teacher views knowledge from a constructivist perspective, the question then becomes, how can technology be effectively integrated?

In social and developmental psychology, according to von Glasersfeld (1994), constructivist models view the learner as a builder of knowledge, not a passive receptor, but an active constructor. Two important notions orbit around the simple idea of constructed knowledge:

> "The first is that learners construct new understandings using what they already know. There is no *tabula rasa* on which new knowledge is etched. Rather, learners come to learning situations with knowledge gained from previous experience, and that prior knowledge influences what new or modified knowledge they will construct from new learning experiences. The second notion is that learning is active rather than passive. Learners confront their understanding in light of what they encounter in the new learning situation. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process: they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge (SEDLetter, August, 1996)."

If learning is a constructive process, and instruction must be designed to provide opportunities for such construction, then how can technology be integrated into the instructional processes such that it promotes teachers to teach in "constructivists ways?" The answer may come form a series of research studies described as *constructionism.*

In the 1960's, Seymour Papert and colleagues initiated a research project on how children think and learn and to develop educational approaches and technological tools to help those children learn. From this beginning has evolved a theoretical foundation, which has become known as constructionism. The term constructionism, first

coined by Papert (1991), involves two main tenets. First, it affirms the constructivists' view of learning and asserts that knowledge is not simply transmitted from teacher to student, but actively constructed by the mind of the learner (Kafai and Resnick, 1996). To this constructionism adds the idea that people construct new knowledge with particular effectiveness when they are engaged in constructing *personally meaningful products* (Bruckman & Resnick, 1995). Thus constructionism involves two intertwined types of construction: the construction of knowledge in the context of building personally meaningful products (Kafai and Resnick, 1996). It is through this avenue of "constructing" that technology can be integrated into the instructional processes such that it promotes teachers to teach from a constructivist model.

Participants

The integration of computer technology into PreK-12 education has been described as one way to promote a learner-centered environment where the computer acts as a tool that possesses a cache' of knowledge and the teacher introduces and moderates ill-structured problems and encourages methods for learner engagement. Described as both constructivist learning theory and constructionist methods, interactive learning activities within this environment include developing meaningful products through student publishing, access to vast resources, engaging in simulations, and utilizing communication systems for peer collaboration.

However, computer technology, specifically productivity software such as MS Office, Claris Works, and the variety of authoring tools are updated generally every other year. In addition, various computer networks are seldom configured the same, which provides a variety of pathways and location names for file management. Although there are many similarities between these tools and learners can develop crossover skills, developing instruction based upon any specific tool or application within any particular system seems unwise. Rather, it seems prudent to promote the learner's understanding of the concepts that are the foundation of the applications and file management systems. Therefore, it has been the goal for these authors, engaged in both new teacher preparation and professional development programs for in-service teachers, to model constructionist principals that utilize the integration of technology in a more student-centered learning environment. It is hoped that by providing this type of learning environment, the learners will enhance their teaching practice by realizing they can use these tools in any environment, regardless of platform, application, or network system.

Participants in this study included traditional pre-service students enrolled in a required "Technology in the Classroom" course and veteran teachers engaged in professional development designed to provide instruction into the integration of technology into the classroom. The learning environment was based upon constructionist principals where both groups of learners were engaged in developing meaningful products that provided an introduction to skills and practice utilizing computer applications that could be later integrated within their teaching practice. The authors also considered themselves participants in this study as their instruction modeled the integration of technology from a constructionist perspective, and provided participants the opportunity to engage in activities that utilized the integration of technology.

Pre-service Students

All elementary education majors enroll in ETC 447, Technology in the Classroom, as a requirement of their program of studies. It is a three-credit hour course usually taken during the third or fourth year of their teacher education, and before they student teach. Classes are taught in a lab of 22 Motorola Macintosh clones, equipped with printers, scanners, a Proxima display unit, and digital cameras. A network that includes access to CD-ROM software, student and instructor folders, and fast access to the Internet and World Wide Web links these technologies. Eight to eleven sections of the course are offered each semester and summer sessions to accommodate traditional, cohort, and alternative partnership elementary teacher education programs.

ETC 447 has evolved from a skills-based course, in which students individually completed activities by following a manual of scripted instructions, to a classroom simulation of a Multimedia Content Development Company, where student teams collaboratively complete content-centered projects using carefully integrated technology tools. It is our vision to implement an educational technology course that models authentic practice through hands-on activities and social interaction. This teaching strategy enables our students to "do" technology and "be" desktop publishers and multimedia developers and database managers by using technology tools in a supportive learning environment.

In-service Teachers

The veteran teachers in this study were a group of twenty-one elementary school teachers practicing at a school district in southern Arizona. They were screened and accepted into the eighteen-month technology professional development project with four university educational technology faculty. If accepted through the

application and screening process each participant received an equipped technology cart and software for their classroom in return for their long-term commitment to hands-on participation in technology integration activities and training.

To build cohesion, enhance teamwork, and stimulate ownership of the professional development project a systems approach to learning (Senge, 1990) was taken. The Learning Team, as they later called themselves, was given time during each visit to discuss and plan future topics for curriculum based upon their group decided needs. The educational technology faculty visited on site four times during each of the first two semesters, and then hosted the in-service teachers for a weeklong summer institute on campus. Future plans include four more visits in the 2000 - 2001 academic year to complete the professional development.

The twenty-one teachers participated in strategies similar to those utilized in the pre service ETC 447 model of technology integration. In self-selected small groups they "became" travel specialists or planners of a lecture series and practiced word processing, desktop publishing, database, and spreadsheet skills imbedded in the project. The teachers chose their travel destinations to investigate and promote, or lecture series notable speakers, so that the content was relevant to them. The final product was a group multimedia presentation of their project.

Data Collection

This paper details a collaborative action research approach to (Oja & Smulyan, 1989) investigating teaching technology integration from a learner-centered constructionist perspective. Both quantitative and qualitative data were collected through self-report instruments, email communications, observations and anecdotal notes of instructional sessions, group meetings and personal interactions. The purpose of an action research approach is to provide a better understanding of the interactive processes and promote the improvement of conditions for the participants of the study. Therefore, data were collected from the role of observer/participant. This provided the opportunity to observe and help support the authors in fostering a better understanding and improve the learning process in this particular study.

Surveys, observations, email communications, anecdotal notes, and personal interactions provided both quantitative and qualitative data that gave a detailed account of learning experience regarding the instructional methods during the classes and professional development program. The qualitative data from observations, email communications, anecdotal notes, and personal interactions provided detail on the participants.

Quantitative data collected in the Center for Excellence in Technology Survey provided basic descriptions of the participating learners of this study. The Center for Excellence in Education Technology Survey is a self-report that provides information (5-point likert scale) regarding the learners' comfort using technology. Information on specific technology is also reported. For example, participants report on their self-efficacy using basic computer skills (i.e. word-processing, email, and CD-ROMs).

In addition, The Stages of Concern about the Innovation Questionnaire developed by Hall, George and Rutherford (1977) was used to measure the professional development participating teachers' process of being selected to be technology innovators for their district. This questionnaire assesses seven hypothesized stages of concern about an innovation that an individual moves through when adopting a process or product innovation, i.e., technology. The seven stages are: (0) Awareness, (1) Informational, (2) Personal, (3) Management, (4) Consequence, (5) Collaboration, and (6) Refocusing. This questionnaire utilizes an eight-point scale of 0, 1 (not true of me now), 2, 3, and 4 (somewhat true of me now), and 5, 6, and 7 (very true of me now). The progression from stage to stage indicates the participants' ideas that go from unrelated concerns about technology usage to the total involvement with technology and its impact on the learning process.

In the first stage, the Awareness stage, little concern about or involvement with the innovation is suggested. The Informational stage, the second stage, shows a general awareness of the innovation and interest in learning more detail about it. In the third stage, the Personal one, the individual is uncertain about the demands of the innovation, his or her role with the innovation and his or her adequacy to meet the innovation's demands. The fourth stage, Management, focuses the attention on the processes and tasks of using the innovation and the best use of information and resources. In the fifth stage, Consequence, the focus is on the impact that the innovation may have on the students' outcomes. Collaboration, the sixth stage, focuses on coordination and cooperation with others regarding the use of the innovation. Finally in the Refocusing stage, the seventh stage, the focus is on exploration of more universal benefits from the innovation, including the use of alternative ideas to the proposed or existing form of innovation.

Discussion

There were many similarities between both the campus-based, pre-service group and the professional development group in regard to their self-efficacy of using computers. For example, there was no significant difference between the pre-service and the in-service teachers in their self-efficacy reports of computer use. As table 1 indicates, both groups demonstrated a high level of self-efficacy for using computers for general tasks – 4.201176471 and 4.11047619 out of 5.

	Pre-service Teachers n=34	In-Service Teachers n=22
Mean	4.201176471	4.11047619
Standard Deviation	0.532528359	0.67015279

Table 1. Computer Use Self-Efficacy

Participants in both groups indicated that they desired less constructionist methods. Interestingly, participants, at times, resisted the more open discovery learning methodology and indicated on several occasions that they would rather be provided with very specific "how to" skill instruction using the computers and software applications.

The Professional Development Group

Several participants indicated that they wanted to know how to use the software, become "experts" or "gurus" before they learned how to integrate the technology into their teaching practice. They suggested that learning to use the computer and software was an independent learning objective different from learning how to integrate the technology into the classroom. As one professional development participant commented: "I need to understand how to use this equipment before I can learn how to integrate it into my teaching." Indeed, the professional development group on several occasions requested listed steps for using specific computer applications. This is particularly surprising as members of the professional development group, a) were chosen for the program based on their self-reported technology skills, b) demonstrated generally high self-efficacy for computer use skills, and c) demonstrated a Personal and Management stage at the 80^{th} percentile on The Stages of Concern about the Innovation Questionnaire, suggesting that they have high technology-knowledge of innovating people who had already mastered technology.

The participating teachers were engaged in additional technology training sessions at the same time conducted by various other providers as well. Several individuals indicated that they were receiving step-by-step handouts and worksheets in their other training sessions and asked why they weren't being provided those during this professional development as well.

Indeed, their demand to learn more computer skills continued to the point that their district technology program director made available online skills training for the entire professional development group between the 4^{th} professional development session and the week long summer session, as indicated by this email.

> "I have 20 TEAM members signed up for Teacher Universe. The pre training session is set for Saturday, May 6, 2000 from 8:30 a.m. to noon. I will open up the training to 5 more people today. If you want to view the site before Saturday, go to http://www.teacheruniverse.com See you all Saturday!"

Their desire to have more application skill training was constant through out the professional development training sessions. During a discussion on the project bulletin board about their taking on a specific area to become an expert, as this teacher stated:

> "I also think some of our [professional development group] members are feeling a little computer-deficient, or at least they lack confidence in their own skills. Maybe if we had had some application-based training going on concurrent to our class, it would have been less difficult."
>
> Another teacher may have hit the nail on the head by responding:
>
> "I think one of the reasons people are uncomfortable choosing an area of "expertise" is the term itself. I consider myself to be a damned fine teacher, but not an "expert." An expert in my mind is someone who knows everything about that topic – someone to whom I can go to for the nitty gritty. I am someone, though, that you could come to for advice on teaching. Maybe we need to consider a different term for 'expert'."

Interestingly, this suggests that in an area such as technology, which changes constantly, individuals may have a difficult time seeing themselves as ever being experts or having enough skills. Certainly the participating teachers of the professional development group demonstrated this. One of the NAU faculty members specifically tried to address this at one of the professional development group planning sessions with the teachers when he

stated; "At what point do you consider yourself an expert? I don't have all of the knowledge. I'm constantly learning new technology skills. I don't have all of the answers; I just have more than you at this point. You need to realize that you also have more knowledge and skills than others, and to them *you are a guru*." Indeed, the topic of "How do we get them to realize that this isn't about learning skills, but rather a shift in the learning paradigm?" was discussed often during project planning meetings by the NAU faculty.

Participants indicated on several occasions that they desired specific skill set instructions because they believed it would be easier to learn a step-by-step process rather than having the skills embedded into a more project-based method. Most interestingly however, during discussions of how they might integrate technology into their classrooms, the stated that they thought using the learner-centered environment (Travel Agency or Lecture Series Experts) that utilized imbedding the computer skills into a constructionist model utilized by the NAU faculty would be an excellent way to teach their students. This was in direct contrast to how they demonstrated, in many ways, that they preferred to be taught technology instruction.

The University Pre-service Group

The purpose of providing more learner-centered instruction is to promote greater understanding of the skills and concepts. Students in the university technology course taught by the authors are provided with instruction based upon this constructionist model. Similarly to the professional development group, this group indicated their self-efficacy in basic computer use (m=4.201176471 out of 5, sd=0.532528359), but also demonstrated the desire to learn with greater emphasis on step-by-step methodology. The end of the semester student evaluations included comments, such as this student's:

> "Less content – more explanation. More help sessions, possible written step-by-step instructions for programs and a frequently asked questions handout. More visual aids, such as handouts."

Another student commented that he would have preferred the methodology utilized by the adjunct faculty and stated:

> I observed several other ETC 447 classes while working on class projects and noticed a big difference between my class and the others. Our class spent more time utilizing trial and error to learn material. Other classes spent time moving through material step by step. Our class could have benefited from a little more step by step attention to limit confusion."

These comments suggest that many students desired direct instruction. One student even suggested that he wanted more lecture time by stating; "Dr. T. is cool, but there may have been a little bit too much workload for the amount of lecture time used." Another student seemed to miss the point of "constructionism" entirely. "I would like to have this course be more classroom oriented. I will never build a computer program [lecture series project] again in my life. I can't think that this course is relevant to future teachers."

Not preferring or not understanding the learning methodology that was employed and modeled in this learning environment may have been frustrating, as this student stated: "This course forced me to learn a lot about computers. I had to figure out my programs by myself and this caused much frustration."

Furthermore, cooperative leaning activities are built into the course through team projects and the faculty encourages peer support and collaboration. However, this was seen as not getting the information from the instructor. Indeed, this student commented:

> "It was difficult to get assistance from either the teacher or the GA. Most of the teaching was done by the few students who actually understood what and how to run the programs, which they learned on their own or in other classes."

This student commented that: "Some things taught in the 1st part of the semester, I forgot later. It would be helpful if a handout of some type was given."

Even though these comments indicate that many students would have preferred more direct instruction and that they were frustrated, they also indicated that they learned a great deal. This student stated: "I probably have learned more about computers and technology in 3 months of this class than I have in 21 years of life." Another stated: "The course is a little overwhelming sometimes, but I really learned a lot." Interestingly, this student stated: "This was a great course that really helped me further develop my computer skills."

Conclusions

Conclusions drawn from this study suggest that currently learners may not have enough experience learning with the integration of technology to feel comfortable to take responsibility for this type of learner-centered environment. The participants of this study, especially in the professional development group, may never have been taught from a constructionist paradigm. This could lengthen the time it takes for these learners to feel comfortable with having their instructor in the role of a facilitator of learning, rather than the giver of knowledge. For example, the professional development group presented a challenge for the NAU faculty not because of the lack of technology skills among some participants, but because of their lack of self-confidence of being an *expert*. Furthermore, the university pre-service students indicated their desire for more direct instruction and even commented on their frustration with having to "figure out the programs." However, for those students who saw themselves as experts, the learning didn't appear to be as frustrating. For example, the student who thought that the course was "great" and that it helped her "*further develop*" her computer skills. This indicates that she believed she already had some computer skills. Perhaps, her awareness of her self-efficacy gave her the self-confidence to explore and better supported her engagement in this type of learning environment.

This brings up new questions regarding the maturity or level of background knowledge needed to understand the concept of the integration of technology within the PreK-12 classroom. What does this say about how we prepare our future teachers or provide professional development for our in-service teachers, specifically in the complex area of computer technology? Perhaps as the professional development group member who stated, "Maybe we need to consider a different term for "expert," we educators need to help our pre-service and in-service teachers re-define expertise and try to instill greater self-confidence in their ability to learn the integration of technology into instruction. Although these learners may have not felt comfortable, they did indicate that they learned. Indeed, the professional development group even indicated that they would probably integrate technology into their teaching practice in a similar fashion. Because of the rapid development of computer technology, expert knowledge is constantly changing. Therefore, learners must continually learn by using their current skills and knowledge to explore new programs and technologies. Educators should focus on helping learners build upon their self-efficacy to support their inquiry within this new paradigm.

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Effects of Small Group Practice on Achievement and Continuing Motivation of Adult Re-Entry Students

Susan A. Brewer
University of Phoenix

James D. Klein
Arizona State University

Introduction

Research suggests that cooperative learning influences student achievement, attitude, and perception of social support and self esteem (Johnson and Johnson, 1996). The success of cooperative learning has been well-documented in studies with K-12 students, and to a lesser extent, with college students. However, there has been little focus on cooperative learning in the population of adult learners.

Adult college re-entry students may have an educational experience that is similar to traditional age college students since they are subject to the same course content and academic expectations. Springer, Stanne, and Donovan's (1999) meta-analysis of 39 studies of cooperative learning in undergraduate science, math, engineering and technology settings points to significant positive effects of small group learning on achievement, persistence, and attitude. Wedman, Hughes, and Robinson (1993) compared systematic cooperative learning to direct instruction with undergraduate education majors and found significant differences on learning outcome scores. Additionally, participants in this systematic cooperative learning setting rated working with a group as more beneficial to their learning than listening in class. Likewise, McDonald, Dansereau, and Spurlin's 1985 study of undergraduate psychology students revealed significant differences favoring a systematic cooperative strategy. The favorable difference in achievement was true for measures of both initial learning and for transfer to a subsequent individual learning situation.

On the other hand, Klein and Schnackenberg (2000) found that undergraduates working alone scored significantly higher than those working in cooperative dyads, when measured on knowledge items, but no differences on application items. Klein and Pridemore (1992) found no significant main effect in achievement for undergraduates working in groups or individually, but a significant interaction according to differences in need for affiliation on certain achievement measures. Klein, Erchul, and Pridemore (1994) investigated cooperative learning and type of reward with undergraduate education majors and found that students who worked alone performed better on achievement measures, with significant differences according to type of reward: task reward, performance reward, or no reward.

Adult re-entry students may have learning needs that are quite different from those of traditional college students. Brookfield (1986) and Knowles (1980) suggest that adult learners come into an education activity with an orientation different than younger, traditional students. They posit that adults are motivated to learn in situations where they can relate what they know from life experience to new information, and similarly use new information in service of real-life situations. Cooperative learning may provide an arena in which life experience can be shared among adult learners. Research conducted in specific populations of adult learners, therefore, should be considered along with research on college-level learning.

Thompson and Scheckley (1997) investigated preference for cooperative learning among baccalaureate (BSN) students, according to their status as traditional college students, adults with no prior nursing education, and adults with prior nursing education. For the most part, the preference for classroom teaching methods did not vary significantly between traditional college students and adults with no prior nursing education. However, the adults with prior nursing education rated their classroom experience with cooperative learning significantly higher than did either the traditional students or adults with no prior nursing education.

Cole and Smith (1993) found no significant differences in the achievement of adult students in business English classes, but did observe increased positive interactions, compared to the control group who participated in an interactive classroom where the teacher called on students at random. Cavalier, Klein and Cavalier (1995) found results in favor of cooperative learning for adults in a technical training setting. Trainees who used structured cooperative groups during technical training performed better on a posttest than did those who worked in unstructured cooperative groups. Additionally, there were significant differences favoring structured groups on four of nine attitude measures, structure groups exhibited increased social and cognitive behaviors.

The ability to learn while working in groups, and to be motivated by the experience of cooperative learning settings, may be influenced by status variables such as need for affiliation or sociability (McClelland, 1976; Jackson, 1974). A reasonable expectation is that high affiliation students prefer group work more than low affiliation students. Sutter and Reid (1969) reported that college student with high levels of sociability performed better using cooperative learning with computer assisted instruction. Need for affiliation as a status variable during cooperative learning has been investigated with mixed results. Predictably, Klein and Schnackenberg (2000) found that low affiliation undergraduates reported higher continuing motivation for working alone, and high affiliation students reported greater continuing motivation for working with another person. Klein and Pridemore (1992) found high affiliation students working alone scored significantly lower on application items compared to high affiliation students working individually, and low affiliation students in both group and individual conditions. Also, students who worked cooperatively, regardless of affiliation motive, reported significantly greater overall satisfaction than those who worked individually. Nakanishi (1988) studied undergraduate speech communications students working in cooperative learning groups that were experimentally manipulated to represent varying conditions of motivation. On measures of task-persistence, there were significant differences in favor of students who were prompted that the task was valuable and that a certain level of effort expenditure would lead to a certain level of performance.

The opportunity to work in small informal groups provides an avenue to interact with peers, fulfilling some of the needs of adult learners, and in particular, the needs of students with high affiliation motive. When observed for interaction behaviors within the cooperative treatment, Klein and Schnackenberg (2000) found that high affiliation dyads exhibited significantly more on-task behaviors, and also exhibited significantly more off-task behaviors compared to low affiliation dyads. Klein and Pridemore (1992) found that undergraduates working cooperatively spent more time on task than did those who worked individually, without regard to high or low need for affiliation. Cavalier et al. (1995) found significant differences in social and cognitive behaviors, with increased activity among the structured cooperative groups compared to unstructured cooperative groups. Cole and Smith (1993) observed increased camaraderie among students working in informal cooperative groups, noted in terms of willingness to help group members, expressing excitement over improvement in one another's test scores, and willingness to express that one did not understand a part of the content.

The purpose of the current study was to investigate the effect of informal cooperative learning and the affiliation motive on achievement, attitude and student interactions. The study attempts to extend previous research (Klein and Schnackenberg, 2000 and Klein and Pridemore, 1992) by examining the relationship between affiliation motive and interactions during informal cooperative learning, for the specific target audience of adult re-entry students.

Methods

Participants

In this study, participants were 109 undergraduate business majors enrolled at a private degree completion university for adult learners. University standards indicate that these students are a minimum of age 23, have been employed for two years, and have earned a minimum of 30 college credit hours upon admission.

Procedures

Based on the affiliation scale of the Personality Research Form-E (Jackson, 1974), participants were identified as having a high or low affiliation motive. After blocking by high and low affiliation motive, participants were randomly assigned to one of two treatments—small group or individual practice. In the small group treatment, students worked in homogeneous triads (three with high affiliation motive or three with low affiliation motive) with shared materials, and in the individual treatment students worked individually with their own materials.

The experimental period consisted of two 20-minute lectures and two 40-minute practice sessions within the treatment conditions. The first lecture on the topic of organizational structure was conducted for the entire class, then participants moved to their small group or individual treatment conditions for a 40 minute practice session. After a break, all students returned to their regular classroom setting to receive a 20-minute lecture on the topic of employee motivation. Participants then moved to their same treatment conditions for a 40-minute practice session on this second topic. During both practice sessions, student interactions were observed and recorded. Upon completion of the second practice session, all participants returned to their regular classroom setting and were given a posttest and attitude survey. Participants in both groups were tested together in the same room and performed individually on the posttest, without the use of the workbooks, notes, or textbook reference.

Results

Analysis of achievement scores among the four treatment conditions indicated no significant differences. The equivalency of achievement levels is likely due to the use of instructionally designed materials which included learning objectives, a timed presentation sequence for the instructor's lecture, a set of overhead transparencies to display content points, and student workbooks containing practice items aligned to the posttest.

There were, however, significant differences in attitude. Assessment of attitudes toward small group practice and individual practice included items regarding confidence, continuing motivation, in-class activities, and homework assignments, with six of the eight attitude items indicating significant differences. Participants in the small group condition reported greater confidence than participants in the individual condition, $p < .05$, and greater continuing motivation, $p < .01$. Results also revealed a significant interaction between practice condition and affiliation motive on three of the eight attitude items regarding enjoyment of the practice activity, $p < .02$, belief about one's own ability to learn, $p < .05$, and preference to work in groups during classroom activities, $p < .02$. For each of these three attitude items, follow-up analyses indicated high affiliation participants who worked in a small group had more favorable attitudes compared to high affiliation participants working individually, as well as compared to low affiliation participants working individually. Additionally, there was a statistically significant interaction on the attitude item regarding preference to work in groups for homework assignments, $p < .05$, with high affiliation participants preferring groups and low affiliation participants preferring individual work. Follow-up analyses indicated no significant differences among the treatment condition means on this item.

Regarding student interactions, high affiliation triads exhibited significantly more on-task behaviors (statements intended to accomplish the task, sharing materials, taking turns) than did low affiliation triads, $p < .01$. However, there were no significant differences in helping and off-task behaviors. The qualitative records of trained observers revealed that participants in the small group treatment condition were physically and verbally active during their timed practice, with behaviors such as "moved to the other side of the table" and "held up the organizational chart to demonstrate." Qualitative records for participants in the individual practice treatment also indicated some physical and verbal activity during their timed practice, with behaviors such as "commiserated about the assignment" and "read the newspaper when finished with the workbook."

Discussion

The purpose of this study was to investigate the use of small group practice and affiliation motive on the achievement and attitude of adult re-entry students. Regarding student achievement on selected and constructed response items, no significant differences were found. Similarly, Cole and Smith (1993) found no significant differences in group v. individual work, while others found results in favor of working alone (Klein and Schnackenberg, 2000; Klein and Pridemore, 1992; and Klein et al. (1994). However, the benefits of formal and informal cooperative learning may not be limited to effects on achievement.

Attitudinal factors such as continuing motivation, confidence and satisfaction may well have an impact on academic success apart from achievement scores. Persistence to complete a course and maintain continuous enrollment is vital to adult student re-entering college after an absence of a few or several years. Results on five of the nine attitude measures in this study indicated that participants favored working in small groups. These findings are consistent with results of other researchers in undergraduate and adult learning settings (Klein and Pridemore ,1992; Cavalier et al., 1995; Thompson and Scheckley, 1997; and Klein and Schnackenberg, 2000). The results of one attitude measure, regarding homework assignments between classes, revealed an interaction between affiliation motive and preference for small group or individual work. As anticipated, high affiliation participants preferred group work and low affiliation participants preferred individual work. Klein and Schnackenberg (2000) found a similar interaction between affiliation and preference for group or individual work.

Several researchers have noted increased positive interaction behaviors during cooperative learning. Among the adult learners working in groups in this study, those with high affiliation motive were noted to exhibit significantly more on-task interaction behaviors than those with low affiliation motive. However, there was no difference in off-task behaviors, as was the case in Klein and Schnackenberg's (2000) study with undergraduates. Given the opportunity to participate in informal small groups, adult re-entry students may use the task as a means of affiliating.

Implications of this study point to the advisability of including cooperative learning activities in higher education for adult re-entry students. While individual achievement was not influenced by practice in either a small group or individually, continuing motivation and confidence were noted to be greater with a group experience. These attitudinal gains may positively support adult learners throughout the academic and social experience of completing an undergraduate degree.

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Hypermedia-Based Problem Based Learning in the Upper Elementary Grades: A Developmental Study

Jonathan D. Brinkerhoff
Krista Glazewski
Arizona State University

Abstract

This paper describes the application of problem-based learning (PBL) design principles and the inclusion of teacher and student scaffolds to the design and implementation of a hypermedia-based learning unit for the upper elementary / middle school grades. Results suggest that PBL may be an effective instructional strategy for gifted and talented sixth grade students. Student scaffolding did not seem to impact achievement or student attitudes, however, teacher scaffolding appeared to increase teacher effectiveness, confidence and attitudes.

Introduction

Changing perspectives in curriculum and instruction over the last decade have focused increasingly on the need to revitalize K-12 instruction through a greater focus on understanding of concepts within a real-world context (Gallagher, Sher, Stepien & Workman, 1995). One means suggested for achieving this is problem-based learning (PBL). PBL advocates maintain that students engaged in such learning environments develop more positive attitudes toward learning (Sobral, 1995; Kaufman & Mann, 1997), tend to focus on meaning rather than recall, and achieve essentially the same knowledge level as those receiving traditional instruction (Gallagher & Stepien, 1996). These findings suggest that PBL environments could contribute to improving student learning in K-12 settings.

Implementation of problem-based learning is not without drawbacks, however, one of which is the difficulty associated with providing a sufficiently rich informational environment to support problem-based inquiry (Hoffman & Ritchie, 1997). Hoffman & Ritchie (1997) suggest that the expanding capacity of multimedia may represent one means for providing such a robust environment. Multimedia may afford additional benefits in PBL environments according to Spiro, Feltovisch, Jacobson, and Coulson (1992). They suggest that the multiple exposures to content multimedia provides may increase student learning in accordance with cognitive flexibility theory. Cognitive flexibility theory proposes that in open-ended learning environments, individuals may become overwhelmed initially by the scope of available information. As the learner's understanding of the problem and available resources develops, each additional exposure supports deeper understanding.

A second drawback associated with the implementation of PBL units centers on the lack of experience students and teachers have with learning within open-ended learning environments. For students, such unfamiliarity may result in confusion and uncertainty as to how to proceed (Sobral, 1995; Hoffman & Ritchie, 1997), while for teachers, unfamiliarity with the facilitator or knowledge resource role PBL methodologies require may pose an equally difficult challenge (Hannafin, Hall, Land & Hill, 1994). Hannafin, Land and Oliver (1999) suggest scaffolds, supports for learning efforts when engaging in open-ended learning environments, may enhance learner effectiveness. These scaffolds may take the form of tools, strategies and guides as means for addressing problems associated with these unfamiliar student and teacher roles.

The purpose of this study was to examine the following research questions:

1. Does hypermedia-based PBL represent an effective instructional strategy for upper elementary / middle school students?
2. What are student and teacher attitudes toward the PBL instructional unit?
3. How are student and teacher scaffolds utilized during implementation of the PBL unit?

Method

Design

Design of the hypermedia-based PBL unit was based on two models. The first was the design model for creating problem-based learning units developed by The Center@IMSA, formerly the Center for Problem Based Learning at the Illinois Math and Science Academy. The second was the scaffolding model for open-ended learning environments described by Hannafin et al (1999).

The design process began, as delineated by The Center@IMSA, by identifying conceptual and skill-based learning outcomes as well as the significant characteristics of the learners. For this study, the Arizona State Department of Education Curriculum Standards provided specific learning outcomes for sixth and seventh grade students. The next step was to identify an ill-structured, complex problem based on a real-world context which would provide maximum integrative curricular yield and learner appeal. The problem statement created for this study asks students to adopt the role of adventurer to plan a circumnavigation of the earth by balloon, a task addressing science, social studies, mathematics and English learning outcomes. The resulting unit was named *Up, Up & Away!*. The remaining steps in The Center@IMSA's design process were followed to identify relevant information resources, develop assessments for checking learners' understanding throughout the unit sequence, and build a teaching and learning template which supports learners' thinking throughout the inquiry process by structuring student problem solving through the following seven steps: meet the problem, identify what is known about the problem as well as what needs to be known, define the problem statement, gather and share information, generate possible solutions, evaluate the fit of possible solutions, and present the best fit solution in the form of a performance assessment.

While implementation of The Center@IMSA's guidelines and the suggested unit template provided some measure of learner and teacher support, the design team felt that additional scaffolds aimed at supporting specific aspects of student and teacher performance would likely contribute to increased achievment and attitudes toward the unit on the part of both students and teachers. To provide more detailed scaffolding, the design team turned to the scaffolding portion of the Hannafin, Land and Oliver (1999) model. This model categorizes scaffolds as one of four types: conceptual, metacognitive, procedural and strategic.

The design team first considered scaffolds for students, beginning with conceptual scaffolds. According to the Hannafin, Land and Oliver (1999) model, conceptual scaffolds guide students in what to consider. This guidance may take such forms as a graphical advance organizer or content outline showing superordinate and subordinate relationships. To provide scaffolding of this type, the *Up, Up & Away!* student interface was organized under four conceptual headings: Prior Attempts, Weather & Geography, News Articles and Balloon Design (Figure 1). Under each heading are links to web sites relevant to solving the unit problem.

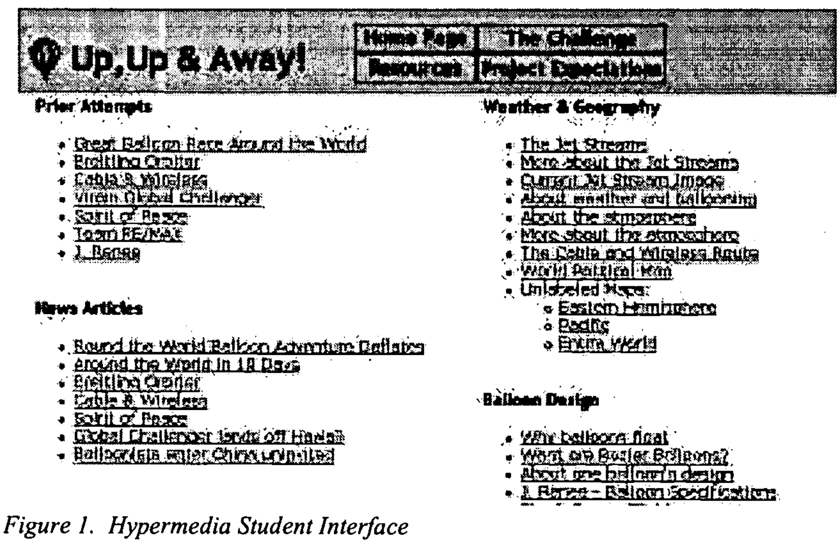

Figure 1. Hypermedia Student Interface

Conceptual scaffolds may also recommend certain procedures or tools at particular stages of the problem solving process. Additional student conceptual scaffolds took the form of a variety of record keeping / data

collection forms designed to support completion of the unit problem. Planning a circumnavigation of the earth by balloon, the unit problem, was divided into three strands: designing a balloon, writing a travel plan, and creating a list of supplies. Students were provided a conceptual scaffold in the form of a data collection document for each of these strands. For example, the travel plan form guided students in their consideration of take off and landing points, countries to be crossed or avoided, determining the projected length of the flight, and choosing the most suitable hemisphere for the flight based on current jet stream winds.

The second type of scaffold described in the Hannafin et al (1999) model is metacognitive, which guides students in how to think as they complete a task. *Up, Up & Away!* provided no metacognitive scaffolding for students. A third type of scaffold, according to the Hannafin et al (1999) model, is procedural scaffolds which guide students in how best to utilize the features of an open-ended learning environment through such things as tutoring, pop-up help, or some other form of job aid. The design team felt that the *Up, Up & Away!* interface was simple enough that student procedural scaffolding was unnecessary beyond a teacher directed introduction to the interface. Lastly, the Hannafin et al (1999) model describes strategic scaffolds as guides for learners in analyzing or approaching a learning task or problem. The design team made a student strategic scaffold available for each of the three strands of the unit through the Resouces button on the *Up, Up & Away!* interface. Selecting the Resouces button took students to a menu page where they could choose an appropriate type of help (Figure 3). Selecting a specific help topic then took students to a strategic scaffold designed to support completion of a given strand of the problem (Figure 4). Students could also download the previously described conceptual scaffolds from these pages.

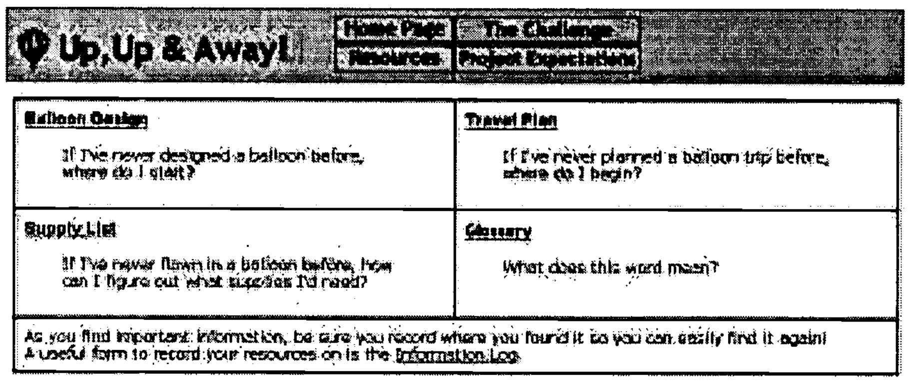

Figure 2. Resources Menu Page

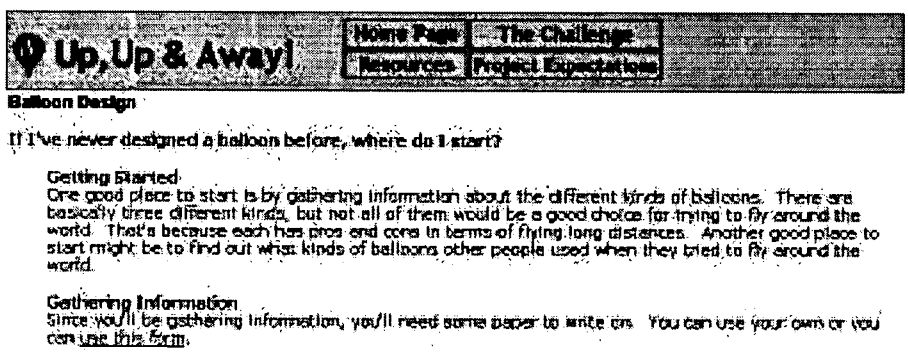

Figure 3. Balloon Design Strategic Scaffold

Once the design team felt scaffolds sufficient to accommodate student success had been incorporated into the hypermedia interface, attention was turned to supporting the teacher. Recognizing that the role of the teacher in implementing student-centered PBL instructional methods might represent an unfamiliar and intimidating situation, the design team focused on scaffolding as many instructionally sound strategies in the unit's teacher guide as deemed essential for teachers to be effective. Teacher scaffolds in *Up, Up & Away!* include conceptual and strategic types.

Conceptual teacher scaffolds guide instructors in what to consider at particular stages of the unit or lesson presentation. For example, according to The Center@IMSA, providing student feedback on progress toward solving the unit problem represents an essential teacher behavior in PBL environments. To support both this understanding and behavior, the design team provided student feedback forms for each of the three strands of the unit. An additional example concerns the necessity for abandoning the familiar role of information provider in favor of monitoring student progress and guiding student thinking. To support teachers in their role as facilitators of student knowledge construction, the design team included questions designed to support this behavior.

Teacher strategic scaffolds serve to guide in analyzing and approaching the unit implementation. According to Hannafin et al (1999), they can take the form of start-up questions or advice from experts. The design team provided a variety of such expert advice to support teachers unfamiliar with PBL teaching techniques, including such things as how to generate enthusiasm for the unit, group students for instruction, and provide feedback.

The next phase in the development process was to perform a formative evaluation. Two trials were conducted.

Trial 1

Subjects

Participants were forty, sixth grade students enrolled in two technology classes at an urban middle school and an instructor in his first year of teaching.

Materials

Materials included the hypermedia-based PBL unit *Up, Up & Away!* and the *Up, Up & Away!* teacher guide.

Procedures

The learning environment consisted of both a 25 station computer lab and the teacher's home room. The PBL unit *Up, Up & Away!* was loaded on the district server and available through a browser on the computers in the computer lab. Due to time constraints, only two strands of the unit, Balloon Design and Supply List were implemented. Students worked in informal cooperative groups of two to three for a total instructional time of approximately eight hours, at the end of which they turned in their final projects. Following completion of the two unit strands, students completed an attitude survey while the teacher participated in an exit interview.

Data Sources

Data concerning implementation of the unit was collected through independent observation by two members of the development team.

Achievement was measured by scoring final student projects according to grading rubrics, one for each strand of the unit. The rubrics assessed quality and completeness of content. Three evaluators scored each student project independently. Final project scores were calculated by averaging the three independent scores.

Student attitudes were measured by a eight item attitude survey. Five Likert scaled items, arranged on a four point scale from Strongly Agree to Strongly Disagree, asked about such things as the ease of using the student interface, student effort in completing the unit, ease of finding information and feelings toward *Up, Up & Away!*. The attitude survey also included three free response items soliciting student opinions on what they liked best about the unit, what would have helped them do a better job of completing the unit, and what they felt should be changed about the unit.

Teacher attitudes were collected through an exit interview which solicited a broad spectrum of feelings and responses toward the *Up, Up & Away!* unit and teacher guide.

Results

Observation data revealed student inattention and confusion in knowing how to proceed. Student scaffolds available through the interface weren't used. The teacher didn't support use of the scaffolds and spent a large amount of time trouble-shooting technical problems and tracking due dates for student projects. As a result, he was frequently disengaged from the students' learning process.

Achievement as measured by mean final group project scores was 45% for the Balloon Design and 10% for the Supply List.

Mean student attitude scores are shown in Table 1. Item one indicated that the majority of students felt working on

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Working on the *Up, Up & Away!* project was fun.	17 %	48 %	20 %	15 %
2. It was easy to find the information I needed in order to complete the assignment.	20 %	43 %	10 %	27 %
3. I learned a lot while completing the *Up, Up & Away!* assignment.	15 %	43 %	27 %	15 %
4. I worked hard on the *Up, Up & Away!* assignment.	40 %	37 %	13 %	10 %
5. I would enjoy working on another project like *Up, Up & Away!*.	22 %	22 %	18 %	38 %

Table 1. Trial 1 Mean Student Attitude Scores

Up, Up & Away! was fun. Item two revealed that a total of approximately 40% either disagreed or strongly disagreed that finding information necessary for solving the problem was easy. For the third item, over half the students felt they learned a lot while working on the project, while on item four, almost 80% either agreed or strongly agreed that they worked hard on the unit. Finally, while 44% agreed they would enjoy working on a unit like this again, 56% felt they would not.

Teacher interview data included an acknowledgment that he hadn't fully read nor used the teacher's guide. The teacher also recognized that he hadn't supported student use of the scaffolds available through the interface. The teacher confirmed that many students were inattentive during the introductory activities and suggested that the reading level of the introductory articles may have been too high. Despite these difficulties, the teacher expressed positive attitudes toward the unit overall and an intention to teach it again, this time with greater attention paid to reading and following the suggested instructional strategies in the teacher's guide.

Discussion

There were several limitations to the first trial, among them the fact that only two of the three unit strands were completed and that the teacher neglected to fully implement the strategies contained in the teacher's guide. Combined results from the various data sources indicated that students were largely unsuccessful in attaining the unit goals. Nevertheless, results of Trial 1did suggest means for refining the unit, as observation had revealed that without teacher guidance, students failed to explore the Help button with the result that many of the scaffolds available weren't utilized. The developers suspected that labeling the button "Help" was ineffective, as the common interpretation of help is generally software assistance, rather than content or learning assistance. Accordingly, the button was relabeled as "Resources". To address teacher concerns that the unit's introductory articles were too difficult, they were edited for readability and additional comprehension questions were provided to support student engagement. Following these changes, a second trial was initiated.

Trial Two

Participants

Sixteen students enrolled in a sixth grade gifted and talented program at a metropolitan elementary school in a large, southwestern city participated in Trial 2. The teacher was an 18 year veteran experienced in student-centered teaching techniques.

Materials

Materials included the revised versions of the *Up, Up & Away!* unit and teacher guide.

Procedures

The learning environment consisted of both a 27 station computer lab and the teacher's home room where a single computer was available. *Up, Up & Away!* was loaded on the district server and available through all the computers. All three strands of the unit were implemented over a period of four weeks. Students worked in informal cooperative groups of three to four for a total instructional time of approximately 20 hours. Upon completion of the unit, students presented their final projects during an evening assembly for parents. Following completion of the unit, students completed an attitude survey while the teacher participated in an exit interview.

Data Sources

Data sources for this trial were identical to the first implementation.

Results

During observations of Trial 2, the development team noted that the teacher used a variety of successful strategies such as actively focusing student activities and monitoring their progress. As a result, students appeared organized, aware of what to do, and confident of how to do it. Student use of the scaffolds available through the Resources button was limited, with most students opting to make notes on their own paper.

Results for student achievement revealed an overall mean score of 97.5% on the final projects as determined by grading according to the unit assessment rubrics. Mean student attitude survey results were largely positive (Table 2). With a ranking of strongly agree or agree, 100 percent of students felt that working on the unit was fun, they learned a lot while completing the unit, and they would enjoy working on another project like "Up, Up, & Away!."

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Working on the *Up, Up & Away!* project was fun.	71 %	29 %		
2. It was easy to find the information I needed in order to complete the assignment.	8 %	54 %	38 %	
3. I learned a lot while completing the *Up, Up & Away!* assignment.	71 %	29 %		
4. I worked hard on the *Up, Up & Away!* assignment.	64 %	36 %		
5. I would enjoy working on another project like *Up, Up & Away!.*	86 %	14 %		

Table 2. Trial 2 Mean Student Attitude Scores

Ninety-two percent of students strongly agreed or agreed that using the hypermedia website was easy. However, 40 percent of students disagreed with the statement that it was easy to find information to complete the assignment.

Results of the teacher exit interview revealed a positive experience. The teacher indicated satisfaction with the learning students demonstrated and an intention to teach the unit again, although she stated a desire for individual achievement data as a means for measuring personal student knowledge gains. The teacher also reported she had read the teacher's guide carefully and that the lesson design structure, as well as the teacher scaffolds, supported her presentation of content with which she had little experience or confidence. She ended by suggesting additional scaffolds that might further assist teachers.

Discussion

Combined results of the various data sources in Trial 2 indicated students were generally successful in attaining the objectives in all three unit strands without making significant use of the scaffolds available through the Resources button. Student success may have been supported by the extensive use of teacher scaffolds designed to motivate and focus student attention and activity employed by the teacher. As the tryout population was composed of students identified as gifted and talented, however, it's not possible to generalize their success to sixth grade students at large.

Based on observations and teacher input, additional changes were made to the unit following Trial 2. In terms of student scaffolds, a self-assessment form was added to assist students in evaluating their own progress. Also added was a Final Presentation Assignment Form detailing presentation expectations to encourage teachers to have students actively present their final projects rather than simply handing them in. Along with the Final Presentation Assignment Form, a Presentation Feedback Checklist was added to support both the teacher and students with giving feedback following final project presentations. The goal was not only to encourage teachers to require student presentations, but to support students in actively listening to their peers' presentations. Additional teacher scaffolds added to the unit included a Student Progress Report form designed to support teachers in monitoring student progress and providing feedback. Also added was a unit review lesson, unit review question bank, and an objective posttest to allow measurement of individual student achievement.

Implications

This study suggests that hypermedia-based PBL may be effective for gifted elementary students. It also suggests that success in this environment may be related to teacher experience with student-centered learning techniques. Student success may also relate to the depth and complexity of web sites included as information resources. Observational data of student behaviors, as well as attitude data showing that approximately 40 percent of students in both trials found locating information on the web sites difficult, suggests that linking more directly to web site pages containing relevant information rather than to a web site's introductory screen may better support student success.

In terms of teacher and student scaffolds and their effectiveness in a hypermedia-based PBL environment, this study suggests that while student scaffolds may not be necessary for student success, teacher scaffolds appear to be important for generating student interest and supporting teacher confidence. For example, the scaffolds providing expert advice for implementing the unit suggest a bulletin board as one means for generating interest. In Trial 2, when the teacher created a bulletin board as well as a Parent Involvement Newsletter inviting parents to a special end-of-unit presentation event, student interest was high. Additionally, the teacher indicated that the scaffolds in the teacher guide supporting presentation of the unit boosted her confidence in knowing how to begin the unit and engage students in a PBL environment.

Further Research

To fully address the suitability of hypermedia-based PBL in the upper elementary grades requires additional study with subjects not identified as gifted and talented. To better measure unit effectiveness through individual learning gains, these students should be assessed not only on the basis of a group project, but with an objective based, individual posttest as well.

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Challenges Faced by Institutions of Higher Education in Migrating to Distance Learning

Stephen L. Broskoske
College Misericordia

Francis A. Harvey
Drexel University

Abstract

This paper presents results of an intensive comparative case study of five colleges and universities using distance education. The study, through interviews with the president and other senior administrators and focus groups with faculty and administrators involved in distance education, found that issues related to faculty and other personnel, marketing, competition, budget, and planning were more significant for the success of distance education than technological issues. Implications for planning and implementing successful distance programs are presented.

Opportunities and Challenges of Distance Learning

Distance learning technologies offer many new opportunities for institutions of higher education. These opportunities include: (a) facilitating improvements in the teaching/learning process; (b) expanding the geographic reach of an institution's programs; and (c) facilitating more effective service of the student population, e.g., offer convenience, greater course selection, and academically richer programs (Smith, 1998).

While educational technologies are a means to facilitate learning, distance learning is more than just an instructional delivery medium. Distance education represents a significant change from traditional instruction (Means, 1994). Distance education breaks from traditional instruction by changing the social dynamics of education, bringing the school to the student (Holloway and Ohler, 1995). Traditional classroom models may not provide the best models for the distance classroom because distance learning is fundamentally different. Instructors cannot simply switch from traditional to distance delivery systems; instead, substantial planning and organization is required to teach in a distance learning environment (Martin & Bramble, 1996; Gibson & Gibson, 1995). Further, students need an orientation to strategies of how to learn effectively in a distance learning environment (Martin & Bramble).

Typically, many institutions begin a distance education initiative encouraged by the many potential benefits, influenced by their competition, and prompted by the fear of not being involved in distance education. Colleges and universities report entering into a distance education initiative without sufficient planning, without a clear mission for the program, and without realizing many of the challenges that will surface as they conduct their program.

Description of the Study

This paper presents the results of a research study conducted in fall, 1999 to examine the challenges facing higher educational institutions in migrating to distance learning. The study consisted of five case studies conducted at higher educational institutions in Pennsylvania. Two institutions were large and three were small; two were public and three were private. Four of the five institutions had been identified as having considerable experience in distance learning.

At each institution the researchers interviewed the president and other senior administrators and conducted a focus group with administrators and key faculty involved in distance education. Participants in the studied reviewed and analyzed a comprehensive model developed by the researchers for applying principles of organizational agility to distance learning.

Data from the individual and group interviews were analyzed using standard procedures for the analysis of case study data. The researchers investigated how institutions of higher education could strategically coordinate human resources, organizational dynamics, and distance learning technologies in a systematic way in order to gain and maintain a competitive edge in the educational market place, and in order to be more responsive to students.

Major Findings of the Study

While many educational administrators focus on technological hardware and software issues, they may overlook more important issues that are integral to success of their institution's distance learning efforts. The authors found that the institutions studied considered technological issues to be of lower priority in designing and conducting an effective distance learning program. The more significant factors that emerged as vital to the success of a distance education program involved human factors, specifically: interpersonal dynamics, attitudes, organizational culture, styles of management, and styles of communication.

The following categories of concern in migrating to offering distance education emerged from the research study:

1. faculty issues;
2. academic issues;
3. marketing/competition;
4. budget/fiscal;
5. planning;
6. personnel issues;
7. technological equipment.

Each of these categories of concern will be examined in more detail in the following sections. Implications for planning and implementing successful distance programs will be presented and discussed.

Faculty Issues

Faculty issues emerged as the major challenge facing institutions in migrating to offering distance education. Many faculty members joined their institutions without experience or knowledge in technology. Fearing changes in working conditions and potential loss of job security, many faculty resist learning about or using distance technologies. Some faculty members stated that they would retire rather than use technology in their classroom. Administrators found that they must work to educate faculty and to encourage them to participate in distance education. Overcoming faculty resistance to distance learning emerged as the major issue in conducting a distance learning program. For example, faculty resistance is visible in the influence of the faculty union within public institutions. Faculty unions complicate the course approval process for distance courses, pressure the faculty to not participate in distance learning activities, and lobby for significantly increasing financial remuneration for faculty participating in distance courses.

Academic Issues

Faculty members mentioned many academic challenges to offering distance courses. Among these were the challenges of:

1. intellectual property rights;
2. having distance courses pass through the course approval process;
3. exam honesty for remote sites;
4. providing an adequate help desk to support students;
5. the need to provide orientation programs for distance learning students;
6. the need to address residency requirements for distance programs.

Marketing and Competition Issues

Institutions were concerned with institutional reputation and image when it comes to offering distance education. They realized that distance education will expose the quality of their program, and they feared that offering a poor quality program may damage their reputation. While institutions felt pressure to get involved in distance learning, they were concerned with competing in a market against private, for-profit institutions that exclusively offer distance education. Institutions were concerned about their program mission and about specifically defining their niche regarding offering distance education.

Budget and Fiscal Issues

All of the institutions mentioned budget issues quite frequently. Issues of special concern were ways to fund the high startup costs involved in distance learning and the funding the ongoing costs involved in offering distance learning programs. The need to use scarce resources more efficiently is prompting all of the institutions studied to identify their core competencies (those areas in which they excel), and to use these core competencies as the basis on which to enter the distance learning arena. Further, in order to function more efficiently and effectively in an increasingly competitive environment, all of the institutions presented evidence of seeking out partnerships

with other institutions where it enhanced their distance learning academic programs. All reported realizing considerable benefits from partnering, including increased efficiency, enhanced program efforts, and positive experience for faculty.

Planning

Subjects at each of the five institutions studied reported that past planning for technology and distance learning was insufficient. Several institutions demonstrated a need for assistance in long-range, strategic planning for technology. Subjects from two institutions indicated failed attempts at strategic planning.

Subjects from two institutions expressed concern over their inability to finalize certain key decisions in this area. Further, subjects from two of the small, private institutions indicated a need to make definitive decisions, which if not made would seriously impede further institutional progress.

Two institutions indicated that planning receives more attention after an institution has been involved in distance learning for about two to three years, after personnel become more aware of the realities of distance learning and the need to invest in more conscientious planning. Although evidence of basic planning regarding distance learning was found in the two public institutions, as stated earlier, evidence of more careful, conscientious planning was found in the two small, private institutions.

Personnel Issues

In addition to challenges related to faculty, challenges related to hiring and dealing with non-faculty personnel also surfaced in the study. Problems cited included difficulties in identifying and hiring qualified distance learning coordinators, which are related to the problem of offering competitive salaries for distance learning technical personnel. One institution reported hired a technology director who was ineffective in relating to and dealing with faculty. This person, apparently more concerned about the equipment than the people involved, prevented the faculty from practicing and using technological equipment, and set back the institution's distance learning efforts significantly.

Technological Equipment

One definite challenge reported by all five institutions studied was designing and implementing distance learning programs is selecting, financing, and maintaining technological equipment. The selection of hardware and software also impacts on staffing decisions. More sophisticated hardware and software may provide greater capabilities for the distance learning program, but the potential advantages will not be realized if the additional competent staff support required and advanced faculty training are not provided at the same time. If the institution is planning on partnering with other institutions, than decision factors in the selection of equipment extend outside of the institution itself to its partners, in order to ensure compatibility.

Implications for Planning and Implementing Successful Distance Programs

Analysis of the data collected from individual and group interviews with faculty and administrators at the five institutions of higher education studied provides support for a number of recommendations for effective practice of distance learning academic programs. These recommendations relate to faculty and staff support, program planning, and program organization. These implications will be discussed below.

Invest In and Support Faculty and Faculty Initiatives

Individuals responsible for developing distance learning programs should attempt to harness the wealth of talent and expertise already available at their institution. Colleges and universities should invest in the faculty by providing ample training opportunities, by capitalizing on the interests of the faculty, and by providing support for faculty initiatives. The institution should create an atmosphere where faculty feel safe to experiment with using distance technologies in new ways. Faculty should be encouraged to explore how to take advantage of the unique capabilities of particular technologies to improve the teaching/learning process.

Initiate Dialogue with Faculty

Be aware that overcoming faculty resistance to distance learning is a major challenge in conducting a distance learning program. Initiate a dialogue between faculty and administrators to determine and address the concerns of faculty regarding distance education. Be sensitive to faculty concerns about changes in working conditions and potential loss of job security.

Educate faculty about the importance of a distance learning initiative to the institution. Involve faculty and support staff by making available: (a) information that describes how effectively the institution is meeting its

mission; (b) information about strategic imperatives being planned and initiatives being undertaken; (c) information about the challenges and problems faced by the institution; and (d) information about the institution's financial stability. Help facilitate faculty's discovery of how distance learning supports the institution's mission, how it helps address particular institutional challenges, and how it adds to the stability of the institution.

Work to Overcome Faculty Resistance and Increase Faculty Buy-In

Educate the faculty about the benefits of using technology in the classroom. Faculty are motivated by the ability to improve the teaching/learning process. Distance technologies hold great potential to enrich the classroom, to connect students with the larger research community, and to bring authentic examples into a lesson. Provide training opportunities to faculty to enlighten them about the benefits of using distance education technologies both for themselves (e.g., connecting with other colleagues, benefits to research) and for their students (e.g., improved access to information resources, networking within a larger community of scholars).

Engage in More Conscientious, Focused Planning

Begin by defining a clear and focused mission for the distance education program. Capitalize on the sense of community on the campus. Open a dialogue between faculty and administrators to discuss the various issues, challenges, and implications that arise in offering distance education.

Hire Technologists with Strong Interpersonal Skills

Technical support personnel with excellent technological knowledge and skills who do not also have excellent interpersonal skills will not be able to support faculty in learning to use distance learning technologies effectively. The interpersonal skills required include in particular the ability to empathize with novice learners and the ability to explain procedures using vocabulary the novice learner can understand.

Develop a Shared Vision

Promote open discussion about distance learning programs involving all levels of the campus community, including faculty, students, and support staff. Do not establish a "top-down" directive. Instead, work cooperatively to produce a shared vision that the whole campus community has helped to develop. This approach will result in an increased number of individuals feeling ownership of the vision, and more people will support the vision.

Plan and Support Migration (Evolutionary Change) Vs. Revolutionary Change

Evolutionary change is less threatening, is easier to implement, and is easier to sustain. Support this migration by investing in faculty training, by providing sufficient support staff, and by supporting faculty efforts.

Integrate Distance Learning Technologies into the Overall Academic Program

Instead of viewing distance education as a separate entity, treat distance learning technologies as effective new tools to enhance the teaching/learning process. Invest in support staff, equipment, and training in order to make the atmosphere conducive for faculty to integrate these technologies into classes on a regular basis.

Provide Adequate Support Staff for Development and Delivery of Distance Learning

Invest in hiring instructional designers and other technological support personnel to relieve faculty of dealing with the technological burdens involved in offering distance learning classes. This will enable the faculty to concentrate on substantive issues instead of becoming bogged down in technical operational details.

Revise Traditional Policies and Practices to Support Distance Learning Students

Realize that distance learning is fundamentally different from learning in the traditional classroom. Consider traditional practices, services, and policies and how they may need to be revised to accommodate the needs of learners and instructors participating in distance education.

Match Distance Learning Technologies to Institutional Conditions and Needs

Select distance delivery systems that provide an appropriate fit with the institution's mission and context. Before selecting delivery systems, ensure that the medium selected will effectively and efficiently address the needs of the institution.

Emphasize the Role of Distance Learning Technologies in Promoting Academic Goals

In addressing the faculty, approach distance learning as a tool with the potential to improve the teaching/learning process. Do not approach it as a way to primarily advance administrative goals without regard to academics.

Elements of Successful Distance Learning Programs

A further review and analysis of the data collected from the five institutions studied revealed a number of essential elements that were shared by all of the distance learning programs that seemed to be positioned for future success in offering productive distance learning programs:

1. Administrators opened a dialogue that involved the whole college community in planning and in developing a vision of distance learning.
2. Administrators were sensitive to the concerns of faculty. They addressed the concerns of employment conditions, job security, compensation, and the faculty's fear of learning and using new technologies.
3. Administrators committed resources to invest in the faculty. They sought to educate the faculty as to the benefits of using technologies, provided training opportunities, provided support for faculty in learning and using technology, and encouraged faculty exploration and experimentation.
4. The institutions attempted to integrate technologies into the traditional classroom to improve the teaching/learning process, rather than introducing new technologies only for distance learning programs. Distance learning was presented as an extension of the use of technology to promote teaching and learning, rather that a means to produce mass education more economically, to increase revenues, or to increase market share.
5. Administrators and faculty realized that distance learning was fundamentally different from the traditional classroom model, and would thus require a reconsideration of various traditional practices, policies, and working conditions. At the least, they openly dealt with these issues as they arose. At best, they initiated steps to determine in advance what these changes were and how they could best be addressed.

Conclusion

While educational technologies are a means to facilitate learning, distance education is more than just an instructional delivery medium. In the process of offering distance education, the institutions studied either discovered or were beginning to discover that distance learning is fundamentally different from traditional instruction in the following ways:

- Distance learning involves addressing changes in historical practice and policy that have to date adequately supported the traditional classroom model.
- An effective distance learning program, by contrast, requires the application of new models of instruction, new instructional methodologies and skills, and new ways to learn effectively.
- Distance learning also involves a change in the ways students are served, the ways academic programs are marketed, and the ways in which instruction is organized and delivered.

In this new environment, educators have had to address many issues, including the following: (a) faculty compensation; (b) models of office hours and other faculty responsibilities; (c) intellectual property rights; (d) supporting students who rarely if ever visit the campus. Further, distance learning provides a vehicle for responding to the educational needs and demands of an information society by allowing instruction to: (a) change from a focus on teaching to a focus on learning; (b) change from memorizing information to harnessing it; (c) become more student-centered; (d) utilize authentic forms of assessment; (e) evolve beyond using the same instructional strategy for all students. The researchers hope that by exploring and exposing some of the challenges institutions face in planning, developing, and implementing academic distance learning programs, their research will help educational professionals realize that the problems they face are common to all institutions. It is hoped that the findings of this study, and the implications of those findings, will improve the practice of distance learning in higher education.

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Using Technology to Enhance Understanding of Leadership

Tricia Browne-Ferrigno
Rodney Muth
Cynthia Choi
University of Colorado at Denver

Abstract

This paper reports the findings of a comparative study of the content of electronic exchanges among members of learning communities to determine what kinds of online dialogue differences--if any--exist. The virtual learning communities compared are two cohorts within the same professional preparation program for teachers aspiring to become school leaders. The content area and instructor are the same for both cohorts; the significant variable is the mode of instructional delivery. One cohort received nearly all instruction through a distance-learning program. The other cohort meets together weekly and uses online activities for approximately 30 percent of instructional delivery. Comparative data used are online messages generated during the first semester of both programs in which leadership was the central focus.

Review of the Literature

Nearly 60% of the nation's higher educational institutions use information technology as a mode of instructional delivery (Lewis, Snow, Farris, & Levin, 1999). As universities increasingly use online learning networks, it becomes important to understand how online interactions support academic success (Cox, 1999). Online environments can enhance learning by shifting from a teacher-centered model in which the instructor is the source of knowledge to a learner-centered model in which peer support, interaction, and collaboration are emphasized (Beller & Or, 1998; Harasim, 1990; Lebow, 1993). Participants communicating within virtual environments use asynchronous dialogue to reflect, debate, critique, give feedback, question, answer, and engage in multiple other communicative behaviors (Henri, 1992; Mason, 1994). Because individuals interacting within a virtual setting share a range of intellectual responses similar to those in other modes of communication (Paccagnella, 1997), online learning activities have potential to provide rich opportunities for learning.

Skeptics of cyber-learning warn that it offers a potentially false or artificial sense of learning that diminishes individual capacity and leads to fragmentation (Heim, 1993). Proponents of instructional delivery through technology maintain that computers promote learning because ample time for quality feedback is available, provide a buffer for those less adept in face-to-face communications, and enhance spontaneity (Bresler, 1990). Some findings suggest that learning in virtual communities increases creative flow and collaborative possibilities (Green, 1996; Knox-Quinn, 1993). Because research about the implementation of successful online environments for learning is a new and evolving area (Cox, 1999), many questions remain unanswered.

The ALPS Program: Cohorts in Professional Preparation

The Administrative Leadership and Policy Studies (ALPS) division within the School of Education at the University of Colorado at Denver (UCD) is authorized by the State Board of Education to offer training for aspiring school principals and administrators (Colorado Department of Education [CDE], 1997). Following the state adoption of professional standards in 1994, the ALPS faculty progressively revised its leadership education program into a problem-based (Ford, Martin, Muth, & Steinbrecher, 1997; Muth, forthcoming), active-learning (Muth, 1999), portfolio-assessed (Muth, Murphy, Martin, & Sanders, 1996) model. The leadership preparation program transformed from a series of on-campus courses into unique off-campus cohorts developed through school district partnerships. Because most ALPS cohorts are developed in partnership with local school districts, unique problems of practice emerge as potential projects and learning events (Martin, Ford, Murphy, & Muth, 1998). Partnership cohort sessions are held at district sites and jointly taught by university professors and administrative practitioners.

As a standards-driven program (Ford, Martin, Murphy, & Muth, 1996; Murphy, Martin, & Muth, 1994), the goal is to endorse graduates as competent professionals ready to assume roles as school leaders. The program is a sequence of four learning domains that concentrate on specific areas of school administration and connect to concurrent field internships. Individual and group activities within the domains center on four broad topics: (a)leadership, (b) school environment, (c) supervision of curriculum and instruction, and (d) school improvement. While each of the domains has an integrated set of field activities to connect content to practice, a 135 clock-hour

intensive internship provides additional immersion in practice and experience as an administrator. Thus, content learning is balanced with field experiences so that students gain clinical skill to recognize and solve problems of professional practice.

The adoption of a sophisticated online communication system by the UCD School of Education opened myriad opportunities to integrate online instruction and learning into the school's licensing programs. The FirstClass Client e-mail and conferencing system, sold by SoftArc and dubbed Colorado Educators Online (CEO), provides statewide service to the school, area districts, and educational associations. CEO "permits synchronous as well as asynchronous communications, easy file sharing, and Internet access" (Muth, 2000, p. 60) and allows creation of discussion sites known as conferences. Within a cohort conference, participants can post questions, comments, and responses viewed by all conference members. Subconferences facilitate completion of special online projects.

Same Program, Two Different Cohorts

The two cohorts within the ALPS licensing program used in this comparative study are uniquely different. Common elements made it possible to link the two case studies for purposes of comparison of electronic exchanges: The same instructor taught the two cohorts during the same domain of the ALPS program. Within each of the CEO cohort conferences, it was easy to identity for analysis students' online messages within the leadership subconference. Hence, the student online exchanges within each of the cohort leadership subconferences in the CEO became the main data source link for this comparison

Virtual Learning Community: Distance Learning Cohort

After intensive curriculum refinement, the ALPS division launched its first DL principal licensing cohort for students who live in areas of Colorado remote from any graduate licensing programs. Participants met together as a united cohort group only twice. The first cohort meeting was an eight-day orientation on the UCD campus in June 1999. An important reason for the face-to-face interactions was to "build a shared culture for a strong cohort and effective cluster groups" (Muth, 2000, p. 65). During the orientation, students selected membership to small support (cluster) groups that were determined by geographic locale and that met at the discretion of the members throughout the yearlong program. Significant blocks of time during the orientation session were used to provide students with instruction and practice in using CEO (Muth, 2000). The DL cohort returned to UCD in July 2000 for its second cohort-wide session. During those two days, students participated in reviews for the required state examination, portfolio defenses, program evaluation, and celebration ceremonies for the closing of the cohort.

Almost all instruction and group discussion in the DL cohort was conducted electronically through CEO. Sources of online interaction data available include (a) open cohort conference discussions and (b) chat room discussions. Personal communications not sent to the cohort's conference were not accessible. Additionally, course syllabi and calendars, student responses to mid-program telephone interviews, and student reflections recorded during exit interviews provide additional data sources.

Onsite Learning Community: Empowerment for Change in Urban Schools Cohort

A university-district partnership was formed in a community within a short distance of downtown Denver. Like other urban school districts, the district faces multiple challenges beyond alleviating its current shortage of potential school principals and administrators: (a) state-mandated accountability measures, (b) political and public scrutiny of student scores and school report cards, (c) limited resources for implementing school renewal measures, and (d) a poorly developed, economically-stressed community support base. The name for this learning cohort, Empowerment for Change in Urban Schools, embodies the vision of its cohort leader for expanding leadership education and skills development into forms of collaborative leadership processes (Napier & Lowry, 1999).

As in other ALPS university-district partnership cohorts, approximately one-third of the curriculum instruction in the ECUS cohort is delivered online. Consistent with the DL cohort, sources of online interaction data in the ECUS cohort conference include the open cohort conference discussions. Data collected through review of artifacts, responses to a questionnaire about CEO use, and researcher observation of cohort sessions provide additional data sources. A larger case study of the ECUS cohort is nearing the close of a year of data collection.

Strategies for Comparative Analysis

Since the two cohorts were in the same licensure program and lead by the same instructor, we assumed that the content and instructional activities within the leadership domains of the distance-learning cohort and the onsite cohort were similar in message substance. Therefore, we developed a coding system to analyze the posted messages in the subconference labeled by the course number for the leadership domain. Both the coding and analyses were

conducted manually. Where needed for further understanding, analysis also included review of cohort syllabi and assignment calendars, observation field notes of the ECUS cohort, and student responses to questionnaires.

Coding Message Types

The display format of messages within CEO allows a viewer to discern quickly the differences between threaded discussions (groups of response messages linked to an initiated message by a common subject heading) and non-responded messages (to which no written reply was sent to the conference). Each of us began at the first message posted in the leadership subconference and classified messages either as a non-responded message (M) or as a group of messages within a threaded discussion (T). All files within a threaded discussion were chunked together and coded as one threaded discussion. Messages within each category were numbered in chronological order by date beginning with the first message to appear in the conference. For messages that evolved into threaded discussions, we classified the first message as an initiated message (I). All response messages, except the last in the series, were coded in one of three ways: R for a general response, Ri for a response directed to the initiator message, or Rr for a response to a respondent message within the threaded discussion. The last message in the threaded discussion was coded similarly to the response messages: C for the last message, Ci for a closing message that referred to the initiator message, and Cr for a closing message that referred to a respondent message. Hence, the coding of message types within threaded discussions shows the connecting patterns of the response messages.

Coding Message Content

Two researcher assumptions about the online communication guided this comparative inquiry and defined the message content codes created and used. Message content codes used to identify specific references within the body of posted messages were developed based upon the following assumptions. First, the predominant content of instructor-generated messages was about online assignments. The instructor used CEO to clarify or redirect the assignment or offer suggestions for action. Despite training for both cohorts in the use of the university's electronic communication system (CEO), the instructor assisted students in overcoming uncertainty or confusion about using CEO during the early days of both cohorts. Thus, content codes were developed to flag content statements related to assignments, suggestions for action, and technical support. Second, cohort use of online communication to support student learning about leadership was different in the two cohorts. Message content codes were developed to identify references to leadership, self-disclosure statements (e.g., statements that begin with the words *I agree, I disagree, I believe, I think*), and professional responsibilities or experiences.

Table 1. Coding Key

Message Type	
Code	Description
I	Initiated message
R	Response (in general)
Ri	Response to initiator message
Rr	Response to respondent message
C	Close of threaded discussion (last message)
Ci	Closed as response to initiator message
Cr	Closed as response to respondent message
Message Content	
Code	Description
a	Reference to assignment (clarification, redirection, reminder, wrap-up)
n	Suggestion for action
r	Reference to professional responsibilities and/or experiences
s	Self disclosure: I agree, I believe, I disagree, I feel, I found, I think
t	Reference to technical support and/or trouble
L	Reference to leadership theory and/or practice

A matrix for analysis of online messages was also developed. Dates of initiated messages and closing responses in threaded discussions were recorded in the matrix. Permission to analyze online messages was obtained from all participants in both cohorts prior to beginning analysis. Thus, the analysis matrix identifies the type and content of each message generated by all cohort participants so that comparisons of student engagement were possible. An ordered triple lists the number of initiated, response, and closing messages made by each individual

within each group of ten messages. A composite totaling all messages posted by each cohort member within the examined conference was included on the last page of the analysis matrix for each cohort.

Additional Message Content Analysis

As our analysis began to reflect marked differences in the type and content of messages, we realized that the use of electronic communication for instruction was not as similar between the two cohorts as we first thought. Needing clarification about the differences between the DL and ECUS syllabi, we asked the instructor if she had changed her online instructional strategies. We learned that she redesigned the online assignments in the ECUS cohort to encourage reflection and discussion in a cohort-wide online conferencing format. In the DL cohort, students were paired and thus shared their reflections and discussions in private messages, which were not available for review by fellow students in the cohort or for analysis by us. Therefore, we realized that our coding of only the posted messages in the leadership domain of the DL cohort failed to present a fair comparison. With this revelation, we analyzed student interactions within the five DL cluster group subconferences. Since cluster groups were created within geographic regions of the state as a way for students to support one another in face-to-face settings, we believed that a cluster group would provide opportunities for shared learning similar to those in the onsite cohort.

Comparative Findings: Some Surprises

A cursory scan of online exchanges within the leadership domain of the two conferences indicated that the two cohorts engaged in markedly different types of virtual communication during the beginning six months of each program. Between June and December 1999, only 57 messages (also called files) were posted in the leadership domain of the DL cohort. Thirty-three of the 57 (58%) messages were instructor-generated. Conversely, although the ECUS cohort met together as a group almost weekly from January to July 2000, the cohort generated a total of 159 messages in the leadership conference. Of those 159 entries, only 20 (13%) were posted by the instructor. An important reason for these variations is due to the differences between the CEO conference structures for the two cohorts. Most of the DL student exchanges for the leadership domain were housed in cluster group subconferences. Nonetheless, the data record strongly suggests that the online interaction within the leadership domain of the DL cohort was less interactive when compared to the online communication among members of the ECUS cohort.

Content of Instructor Messages

Data support our assumption that the predominant content within instructor-generated messages was about online assignments. Of the 33 DL messages posted by the instructor, 25 (78%) provided clarification, redirection, or reminders about assignments and 22 (67%) suggested action to be taken by students. Among the 20 ECUS messages initiated by the instructor, 13 (65%) referenced an assignment and 12 (60%) suggested student action. As the statistics show in Table 2 and Table 3, the instructor used CEO in both cohorts not only as an instructional tool, but also as a messaging system.

Table 2. Instructor Use of Online Messages for Explaining Assignments

Cohort Name	Number of instructor-posted messages	References to providing clarification, redirection, or reminders about work	Percentage
DL	33	25	78%
ECUS	20	13	65%

Table 3. Instructor Use of Online Messages to Suggest Action

Cohort Name	*Number of instructor-posted messages*	*References to suggestions for action by students*	*Percentage*
DL	33	22	67%
ECUS	20	12	60%

ECUS syllabus

A review of the ECUS syllabus indicated that the instructor explicitly described the purposes for integrating online activities into the onsite cohort curriculum.

Traditionally, this domain has been facilitated in a face-to-face environment with some e-conferencing to supplement instruction. As part of an effort to increase accessibility to material away from the classroom and to leverage the advantages of face-to-face contact in the classroom time available, [the ALPS faculty] is converting more of the material into a computer-supported format. Thirty percent of the course material will be offered on-line, providing opportunity for small group discussions and individual reflection between face-to-face meetings . . . learning is both an individual and interactive process that involves identity development as well as interpersonal interaction . . . assignments [were organized] to provide extensive reading and study on one hand and intensive collaboration on the other. (Napier, 2000, p. 1)

The first e-conferencing assignment was presented verbally to the ECUS cohort during the second cohort session (January 31, 2000) and clarified during the third meeting (February 7, 2000). However, based upon a review of observational field notes and a search within the ECUS cohort conference, written directions for the first online assignment were not distributed during a cohort meeting or via an online message. Further, an interesting contradiction in our comparative findings emerged from analysis of the ECUS student comments on the recent questionnaire.

ECUS student reflections about the online assignment.

The student responses to a survey question about the online assignments in the leadership domain provided interesting contrasts in understanding. Nine of the 17 (53%) recalled that the task was to read assigned articles and books and write reactions and reflections generated by the readings. Five students either reported that they could not remember specifics about the assignments or they left the answer space blank. Another student wrote,

> I'm not sure that I really understood why the assignment was assigned. I thought it was more of an inner reflection. I did not feel comfortable expressing my thoughts or feelings with the group. I had not built any trust.

While time often diminishes recollection of details, the fact that 6 of the 17 (35%) students in the onsite cohort could not recall the assignment raises a concern about assignment clarity. Students may have asked the instructor individual questions about the online activity during cohort meetings. However, clarifications about this particular assignment do not appear to have been shared with the entire cohort either in class or online. The lack of written instructions for the first online activity is markedly out of character with the number of other assignment messages posted by the instructor.

An Unexpected Finding: Need for Technical Assistance

During analysis of instructor messages in both cohort conferences, we noticed an interesting finding that emerged concerning the need for technical assistance. Students enrolled in both the DL and ECUS cohorts received training in the use of the university's electronic communication system prior to beginning online activities. Members of the DL cohort received intense, hands-on opportunities to practice using CEO in the university's computer laboratories during the cohort's eight-day program orientation. Online training for the ECUS cohort included a visual-display presentation by a guest speaker during the cohort's second meeting and one-on-one assistance provided by both the instructor and peers during two of the subsequent class meetings in a middle-school media center. Despite training in the use of the communication system, data indicate that students in both cohorts reported technical difficulties and received guidance from the instructor throughout the entire timeframe examined.

References to technical support or trouble appeared in 27 of the 57 (47%) of DL cohort messages. Eleven of the message types were non-responded messages generated by the cohort instructor. Six message types were threaded discussions initiated by different students with only the instructor responding. Only two of the threaded discussions concerning technology in the DL conference were initiated by students and responded to by peers.

References to technical support or trouble appeared in 14 of the 159 (9%) of the ECUS cohort messages. Three of the instructor-generated non-responded messages link technical support to another assignment. Eight student references to uncertainty about CEO appeared within both non-responded messages and threaded discussions among students during the first two weeks of the assigned online activity. The last reference to technical trouble made by a student was found in a response to an instructor's message about completing an online assignment. In this instance, the student wrote that he was unable to participate in one of the online activities because the system was off-line when he tried to complete his work.

A comparison of the number of references made by students about having difficulty using the online communication system or to the instructor providing technical assistance leads to interesting questions. Statistics are provided in Table 4.

Table 4. Student Need for Technical Support

Cohort Name	Total number of messages	References to technical support or trouble	Percentage
DL	57	27	47%
ECUS	159	14	9%

We became intrigued: Does the fact that half the messages posted in the early weeks of the DL cohort suggest that the students were more dependent or needy than the students in the onsite cohort? Or does the small percentage of references to using CEO in the ECUS cohort mean that technical problems were handled in class? It may be tempting simply to assume from the statistics that the DL cohort experienced and reported greater difficulty using the online communication system than the ECUS cohort did. However, ECUS student responses to a recent questionnaire about using CEO suggest that learning the online communication system created problems for students in the onsite cohort as well.

ECUS student reflections about using CEO.

Eleven of the 17 (65%) respondents stated that they did not encounter major difficulties using CEO. The range of challenges for five other respondents included simply not being able to log-on because of an incorrect spelling of user name to needing additional training from the CEO administrator or a spouse. However, one student reported significant difficulty and did not engage in online activities until two weeks after the assignment had been made. Once she learned to use the electronic communication system, she participated as actively as the majority of her peers.

> I almost died learning CEO. It took several weeks to feel comfortable understanding and using the system. I first had to get hooked up to an Internet provider, then to a search engine to be able to use on my laptop. Then I had to load CEO First Class . . . [and] learn how to navigate around in the system. The class names were even foreign. I worked and worked until I became comfortable using the system.

Studnt Learning through Online Activities

Our quick scan of the data record (i.e., the number and types of messages in each leadership conference) suggested to us that participants in the ECUS cohort engaged in rich, dialogue-like exchanges within the leadership domain conference, which students in the DL cohort did not. DL students may have engaged in very similar discussions with another student in the cohort, but their exchanges occurred within private mailbox messages or subconferences. Thus, students in the DL cohort missed opportunities to share their learning and understanding with the group at-large.

References to leadership.

A review of the statistics shows how very different the contents of the messages are in each of the cohort conferences. The word "leadership" was used in 58 of the 139 (42%) ECUS student messages, but it appeared only 3 times in the 24 (13%) DL student messages. This finding both amazed and puzzled us. We purposefully selected the leadership domain conference in each cohort as the course for our comparative analysis, assuming that both cohorts followed a similar structure. We learned from the instructor that she observed the same phenomenon in the DL cohort leadership conference that we did. Thus, she purposefully made a dramatic change in the format of the online curriculum for the ECUS cohort in order to create a structure for sharing learning cohort-wide.

References to self-disclosure statements.

We measured the vitality of online communication by evidence of the number of times that students made self-disclosure statements in which they used the following phrases: *I agree, I believe, I disagree, I feel, I found, I support,* or *I think.* Self-disclosure statements appear in 110 of the 139 (79%) ECUS student messages and 14 of 24 (58%) DL student messages. An interesting observation is that only six instructor messages in the ECUS cohort contained self-disclosure statements. Conversely, the instructor used self-disclosure statements in 25 of her 33 (76%) messages in the DL cohort.

References to professional practice.

Additionally, data indicate that students in the ECUS cohort attempted to connect what they were learning in the licensure program to their professional responsibilities or experiences. Fifty-one of the 139 (37%) student messages include reflections in which professional responsibilities are mentioned. None of the student messages in the DL conference make a reference to professional responsibilities or experiences. A summary of findings is presented in Table 5.

Table 5. Student Learning through Online Activities

Cohort	Number of student-posted messages	References to leadership	Made self-disclosure statement	References to professional experiences
DL	24	3	14	0
ECUS	139	58	110	51

DL cluster groups.

The disparity between the leadership messages compelled us to look elsewhere in the DL cohort. Five cluster groups were formed during the orientation session of the DL cohort in June 1999 with the intent to build local communities of support for the geographically dispersed cohort members. An interesting finding is the incredibly wide range of student online interactions within the five cluster group subconferences during the entire yearlong program. The least active group posted only 35 messages while the most active one, known as WestSide, exchanged 344 messages. The other three cluster groups generated a total of 83, 67, and 64 files each. The range in quantity of exchanges among the five cluster groups poses interesting questions about group dynamics, which were not addressed in this inquiry. What is significant about this finding is that the WestSide cluster group was also the most social cluster group in the DL cohort. The intensity and volume of peer-to-peer interactions within the ECUS cohort and the WestSide cluster group suggest that peer-to-peer support and encouragement developed because of opportunities for face-to-face interaction. Analysis to date of the interaction within the DL cluster group subconferences shows a greater number of student exchanges than in the leadership conference. Although the messages within the DL leadership conference were somewhat stagnant, the richness of cohort activities became apparent within cluster group subconferences. References to leadership practices, professional growth, and the challenges of balancing the licensure program requirements with professional responsibilities were mentioned in the subconferences.

ECUS student reflections about online learning.

Statistical analysis provides only one perspective of student reaction to the required e-conferencing activities. Thus, we returned to the ECUS questionnaire for more clarity of findings. Only 7 of the 17(42%) student responses to the recent ECUS questionnaire provided positive assessment of the online assignment. One of those students wrote a particularly enthusiastic evaluation.

> I personally love this type of assignment. I believe that [it] is appropriate for the graduate level and gets people out of the "regurgitation of information" mode. As I observe others in the cohort, I detect that many are not dedicated to this method of learning . . . This assignment, however, [prodded us] to think deeply and investigate, evaluate and speculate.

An interesting observation about this student in cohort meetings is that over the past 10 months he rarely participated in face-to-face discussions. Like other more reticent students, he seems to prefer online sharing.

> I appreciate the convenience of online discussions . . . the discussion topics and the venue allows people to be more introspective and share personally. I think there is a huge potential for online components.

Other students who enjoyed doing the online leadership activity wrote:

> Definitely a new and fresh approach! I like [online activities] because you can sit at home and have time to reflect and write your thoughts.

> I enjoyed the technological side of this assignment. Using a computer and the Internet to discuss class topics is very fascinating. Doing this kind of assignment, however, made me nervous because I had not explored myself as a true leader.

However, almost half of the ECUS cohort did not share the same reaction to being assigned online dialogue activities. Five students reported feeling overwhelmed, perplexed, worried, and even threatened about writing self-disclosing reflections.

> I struggled with this assignment because I truly had not seen myself as a leader. I was apprehensive to put those words online for all to read.

> I felt threatened because I was asked to expose my inner thoughts to 20 people that I did not know.

Approximately one-third of the respondents reported that they did not enjoy the online conferencing for other reasons. It was frustrating for some when peers did not respond to the messages they initiated in the hopes of beginning threaded discussions. Others voiced a preference for face-to-face discussions in which there is increased potential for peer interaction.

> [Not receiving responses to posted messages] affected me by making me feel that what I had to say was not important. I also began to feel like "why should I even do this if it is not even read or responded to by anyone."

> [Using CEO for assignments] is a nice up-to-date way of trading ideas and work. I would like to see it used more, but nothing beats face-to-face communication and learning.

Comparison of student engagement.

A line-by-line analysis of type and content of student messages in each of the leadership conferences suggests that many students never fully participated. Analysis of student responses in the DL leadership conference matrix indicates that four students never posted a message there during the entire program. Analysis of the ECUS matrix shows that many students were hesitant during the early weeks to share self-disclosures with their peers. One student did not engage in the process until three weeks after the assignment was made. Among the four messages he posted in the conference, only one contains a self-disclosure statement. Another student did not post any messages until almost five weeks after the assignment was made. Of the seven messages authored by this student, only four contain self-disclosure statements.

Conclusions and Possible Questions for Discussion

Comparative analyses of the online messages in both conferences strongly suggest that neither cohort spent time establishing ground rules for online behavior. What emerged during the process of online communication worked for some students, but not for others. Thus, the use of the online conferencing system as an instructional tool differed significantly between the two principal licensing cohorts.

The DL cohort used the CEO system more as a communication tool for discussion of logistical issues related to their learning and assignments rather than as a platform for academic discourse. Only one of the five cluster groups within the DL cohort sustained rich online communication throughout the entire program. Perhaps one reason for the online connectedness of this DL cluster group was the fact that the students initiated and sustained regular face-to-face meetings to support one another.

The onsite ECUS cohort used the CEO system as an instructional tool because the purpose for online activities was clearly delineated in the leadership course syllabus. Confusion about the first assignment arose for two reasons: (a) the assignment was not written and (b) some students had difficulties learning to use CEO during the early weeks of the program. Nonetheless, the majority of the ECUS students posted personal reflections and engaged in rich, peer-to-peer online discourse about their assigned readings and related their learning to professional responsibilities. In some ways their online dialogue rivaled discussions observed during weekly cohort meetings.

Because our study did not compare truly similar online learning environments or include large numbers of students, our findings are limited. Results of our analysis of the content of student messages provide important information to assist the ALPS faculty in the design of future distance-learning programs and online assignments within onsite cohorts. Student responses to the questionnaire about use of CEO in the professional preparation program contain some surprising revelations that can further assist in program modification. Adult learning styles

vary tremendously and thus accommodations need to be made so students have ready access to technical assistance in the use of information technology during the early weeks of a new program. Further, cohort norms need to be established early regarding participation in online activities.

Findings in our comparative study support the literature base and empirical evidence from other studies about online communication. A greater value is that our findings generated questions for discussion about the effectiveness of online learning activities.

Question One: Student Engagement in Online Activities

Data from our comparative study show that not all students in the two cohorts readily embraced the idea of actively participating in asynchronous online dialogue. While some students in the ECUS cohort reported enjoying online activities, their peers revealed reticence for sharing personal views and reflections in the public domain of an online conference. Several students reported having technical difficulties during the early weeks of both programs. Further, three ECUS students posted three or fewer messages among a total of 139 student files, and four of the students in the DL cohort never posted a message within the leadership domain conference. A stated purpose for assigning online activities is to enhance collaborative learning. Therefore, if student participation is important for learning, then what type of monitoring does an instructor need to use to assess student online engagement?

Question Two: Online Conferencing and Student Learning Styles

In face-to-face classroom situations, some students are very willing to share their thoughts and ideas openly as fuel for discussion and debate among peers. Other students prefer to listen and observe classroom exchanges and reflect about what was said. An instructor can notice facial expressions and body language to discern if quiet students are engaged in the classroom activity and even elicit responses through direct questioning. In a virtual environment, however, an instructor cannot always discern if "quiet" students are actively participating. The fact that a message has been opened does not mean that it was read. Therefore, what strategies can an instructor use to monitor active student participation in online activities?

While our comparative study of message content was intended to assist the ALPS faculty in the design of the next distance-learning cohort and the integration of more online activities in onsite cohorts, our findings suggest questions for discussion with larger audiences. We begin that larger dialogue with this presentation.

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How To Develop Cognitive Flexibility In A WWW Course

Ana Amélia Amorim Carvalho
University of Minho

Abstract

Cognitive flexibility is indispensable for applying knowledge to new situations. The development of this ability depends on certain conditions such as the attainment of a deep comprehension of the subject matter and the exposure to different knowledge representation. This paper focuses on these conditions and describes a study designed to foster the development of cognitive flexibility on a World Wide Web course.

Cognitive flexibility

Cognitive flexibility is the ability to change one's perspective, to categorize data and stimuli according to different properties, to find new connections among the elements of a whole and to interpret the same reality in different ways. It is also the ability to recombine elements of a representation, or to reorder the importance of elements in different contexts (Spiro et al., 1987). Flexibility in thinking allows subjects to move from one category to another and to modify their point of view (Guilford, 1967).

Spiro & Jehng (1990: 165) state: "by cognitive flexibility, we mean the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands". Moreover, "this is a function of the way knowledge is represented (e.g., along multiple rather single conceptual dimensions) and the processes that operate on those mental representations (e.g., processes of schema assembly rather than intact schema retrieval)". According to these authors cognitive flexibility depends on the way knowledge is represented. Bearing this in mind, next session focuses on knowledge representation, particularly on complex knowledge representation.

Knowledge representation

The representation of complex knowledge, according to several authors, has to avoid compartmentalization, simplification, and a single dimension of analysis (Barthes, 1970; Morin, 1990; Spiro et al., 1991). Multiple dimensions of analysis are necessary for developing cognitive flexibility that depends of having a diversified repertoire of ways of thinking about a conceptual topic.

"Interpréter un texte, ce n' est pas lui donner un sens (plus ou moins fondé, plus ou moins libre); c' est au contraire apprécier de quel pluriel il est fait" (Barthes, 1970: 11).

Cognitive Flexibilitty Theory (CFT) proposes principles that help to develop cognitive flexibility (Spiro & Jehng, 1990), such as "knowledge deconstruction" and "thematic criss-crossing". At this point it is important to stress that this theory is case-based. A case represents specific knowledge tied to a context. It may be a chapter of a book, a few frames of a film, an event. Cases may have different shapes and sizes, covering large or small time slices (Spiro & Jehng, 1990; Kolodner, 1993; Kolodner & Leake, 1996). Each case has to be divided in small parts, called mini-cases. Each mini-case is analyzed according to multiple dimensions or multiple perspectives: the themes.
Themes are synonymous of principles or rules and they help to understand the complex knowledge. Each perspective or theme gives a new insight into the mini-case comprehension.

According to CFT there are two important paths to develop cognitive flexibility: "knowledge deconstruction" and "thematic criss-crossing". In the next section we describe the two paths illustrating them with an example: the web document "Cousin Basilio: multiple thematic Criss Crossings" (available at the following URL: www.iep.uminho.pt/primobasilio), ", for literary studies, we select a 19th century novel, "Cousin Basilio" written by Eça de Queirós.

Two complementary ways of knowledge representation to promote cognitive flexibility

Knowledge deconstruction

The notion of *knowledge deconstruction* is shared by R. Barthes, J. Derrida and R. Spiro and it stresses the importance of multiple perspectives to deeply understand a subject matter. According to CFT the process of knowledge deconstruction implies the selection of *themes* and *cases*. The case is divided in small parts, the mini-cases. For each mini-case it is necessary to identify the relevant themes. Then, for each applied theme a "Thematic Commentary" has to be written, explaining how each theme applies to the particular mini-case. This text (thematic commentary) should state clear ideas in a simple language and it should be short to be easily read in a computer screen (see figure 1).

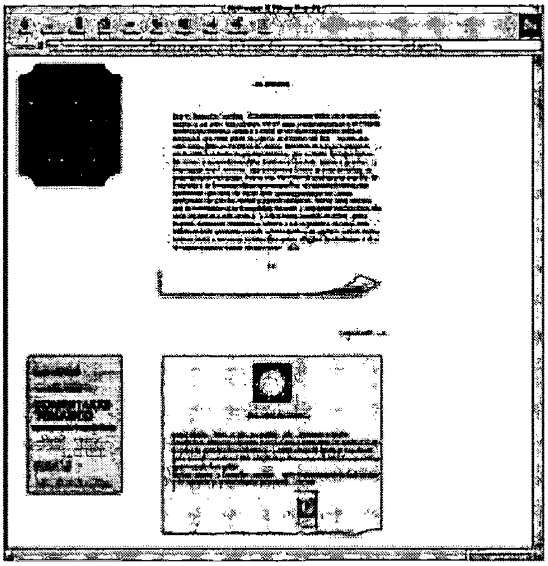

Figure 1 - Mini-case and Thematic Commentary of "Cousin Basilio"

In the web course that we developed "Cousin Basilio: multiple thematic Criss Crossings", we identified nine themes to approach the novel. This novel has sixteen chapters that we grouped to constitute the cases (table 1). Each case was divided in small parts, the mini-cases. Then, we identified the relevant themes to each mini-case and we wrote the thematic commentaries (see table 1).

For example, four themes apply to the first mini-case of Case I (see figure 1). The Thematic Commentaries related to each of these themes, give different and complementary insights to the text. On figure 1, one can see, on the right side, a mini-case and below it the text of the first Thematic Commentary.

Chapters	Cases	Mini-Cases	Thematic Commentaries
I - III	I	8	37
IV - V	II	7	37
VI - VII	III	6	35
VIII - XIII	IV	9	36
XIV - XVI	V	4	15
Total	-	34	160

Table 1 – Components of the process of deconstruction of "Cousin Basilio"

As "Cousin Basilio" action is carried out in the 19th century, for each mini-case we included information about the epoch. This information focuses on clothes, furniture, transportation, writers, composers, operas or novels mentioned in the mini-case. This information includes not just text but also pictures and video clips.

Flexibility in applying knowledge depends on mini-cases being deconstructed (through themes and thematic commentaries; the user attains a deep understanding of that mini-case) and it also depends on rearranged structural sequences from different points of view or perspectives (thematic criss-crossings). Knowledge that have to be used in many ways has to be learned, represented and tried out in many ways.

Thematic criss-crossing

The process of *thematic criss-crossing* is inspired in Ludwig Wittgenstein' book "Philosophical Investigations". According to Spiro & Jehng (1990), Cognitive Flexibility Theory generalizes Wittgenstein's metaphor of the criss-crossed landscape. The authors explained that "by criss-crossing topical/conceptual landscapes, highly interconnected, web-like knowledge structures are built that permit greater flexibility in the ways that knowledge can potentially be assembled for use in comprehension or problem solving" (Spiro & Jehng, 1990: 170).

After the selection of a theme (or a combination of themes), thematic criss-crossing guides the user through a sequence of mini-cases (of different cases) and thematic commentaries to which the selected theme applies. For example, figure 2 exemplifies the process of thematic criss-crossing. In that example it is used the first traversal: "Denouncement of decadence". The sequence presented to the user does not have to respect the cases sequence (figure 2), but it has to be meaningful and give a deeper and multifaceted understanding of the theme.

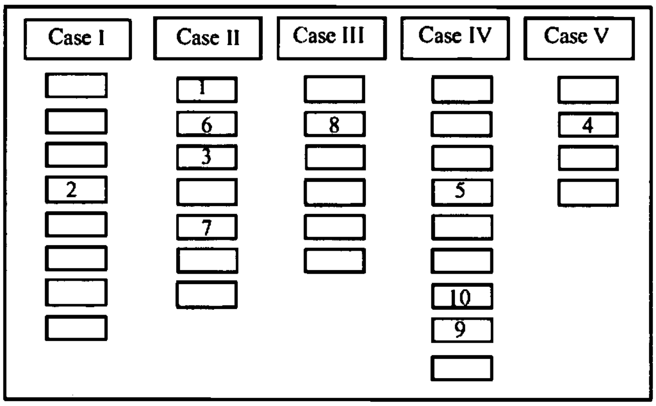

Figure 2 - Thematic Criss-Crossing (Denoucement of decadence)

"The same content material is covered in different ways, at different times, in order to demonstrate the potential flexibility of use inherent in that content" (Spiro et al., 1988: 379).

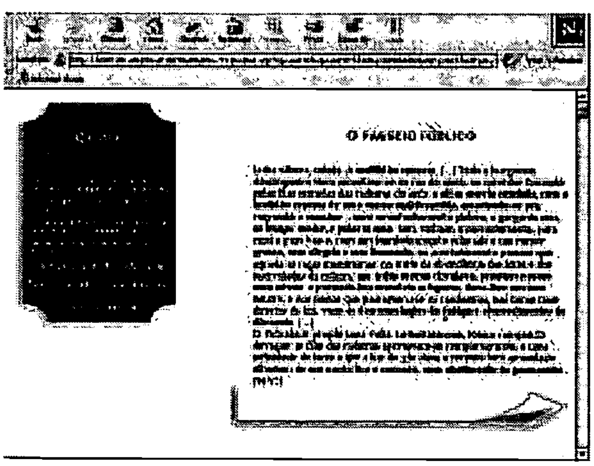

Figure 3 - Thematic Criss-crossing (mini-case)

Both processes are complementary in the kind of learning promoted, and they have to be explored alternately. As users explore the mini-cases and the thematic criss-crossings, they will be familiar with some mini-cases that they can read for different purposes. Bearing this in mind we decided to use the bold style to give evidence to several expressions, sentences or words that are relevant to the thematic criss-crossing (see figure 3). In a glance the user identifies the mini-case, then he/she will focus on the bold text.

The importance of cognitive flexibility to knowledge transfer to new situations

Transferring knowledge to new situations is a very demanding task. This level of transfer is considered to be the most difficult and is referred to as "far transfer" (Gick & Holyoak, 1987). It is necessary to master a subject and have the ability to restructure the knowledge to fit or solve the new situation, e.g., it is necessary to have cognitive flexibility. The mentioned authors consider also two other levels of transfer: "self transfer" or knowledge reproduction and "near transfer" where there is a similarity between the new situation and others analyzed.

Structure of the World Wide Web Course

We developed a literary studies course in the web to support the study of a novel, "Cousin Basilio", that describes the social life in Lisbon in the 19th century (http://www.iep.uminho.pt/primobasilio), as we mentioned above. During the design phase we took in attention the utilization of icons and colors that helped to recreate the 19th century ambience in the web document "***Cousin Basilio*: multiple thematic criss-crossings**". For example, the Thematic Commentary background is an ancient official Portuguese stationery and the mini-cases background represents an old (yellow) page, inviting the user to pursue due to its slightly rolled page on the right corner (figure 1).

Menu1	Main1
Menu2	Main2
Footer	

Figure 4 - Web site areas

The web pages are structured according to three main areas (figure 4). From top to bottom, we have the Menu 1, that is the Main Menu. If we select an item on this menu the information will be available on the Main 1 (figure 1). Then, on the area below, we have the Menu 2. This menu is dynamic because the items available on this menu depend on the options selected on the Menu 1. The item selected on the Menu 2 will be available on the Main 2 (see figure 1). The last area is called footer, and besides copyright information and e-mail address, there is also the possibility of the user to write his/her personal notes, clicking on the pen (see figure 5).

The menu 1 offers four options: *Cases* (knowledge deconstruction); *Thematic Criss-Crossing; Search;* and *Table of Contents*. On the menu 2 we have access to "*thematic commentaries*", information about the *Context* of the 19th century and about the text (mini-case) of the novel, and a general description about the nine *Themes* selected for approaching the novel. Some mini-cases have pictures that help to understand Lisbon scenarios or some ancient transportation or even some ancient furniture that helps to recreate and understand that century. Other mini-cases have a video that presents information about the novel. Finally, at the end of Menu 2, we have *References*, listing all authors mentioned in "thematic commentaries" or in the general description of Themes.

Instructions are provided to the user each time he/she selects an item (path) on the Menu 1. These instructions in blue simulate well-designed handwriting (figures 5 and 6).

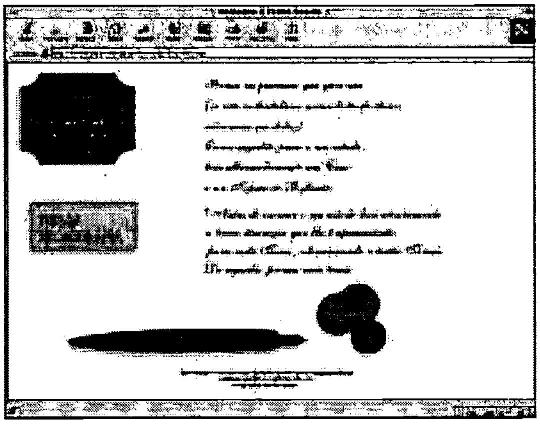

Figure 5 - Instructions to the user

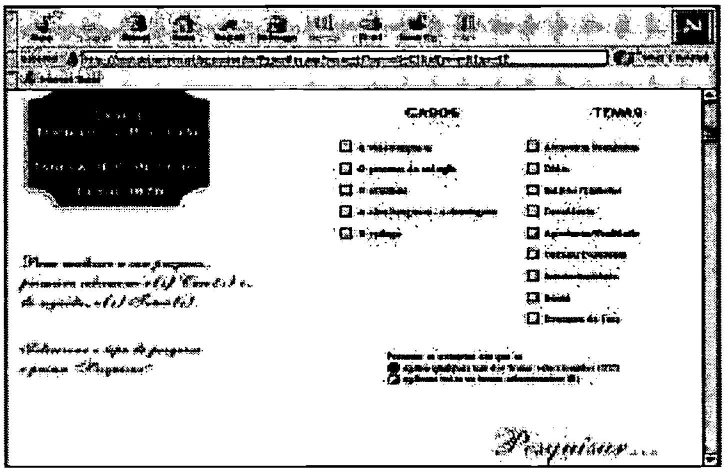

Figure 6 - Search (cases and themes)

The home page has an image of an ancient book. It gives access to the Help page. On this page, one may obtain information about the approach used to the novel and about the options available on both menus. If the coins are pressed, one has access to the login page (figure 7). User name and password will be required. This document is access free, however, the password is needed to save one's own notes (during a month from last access). Feel free to look. These web pages are discrete and simultaneously appealing. Most of the web courses available have a high text density , which is not motivating for the user! Why aren't we exploring the web multimedia potentialities?

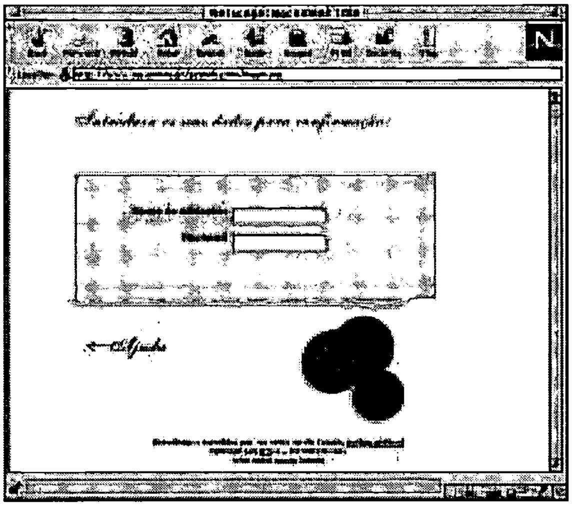

Figure 7.- User name and Password (access free)

The study

In this study we evaluate how far the course structure contributes to the development of cognitive flexibility. We use two groups and two different documents. One of the documents gives access to all CFT facilities (named CFT) and the other one does not have access to Thematic Commentaries (named NTC - No Thematic Commentaries), but only to the applied themes to each mini-case.

We developed several instruments to collect data such as knowledge tests (for measuring far, near and self-transfer questions); Questionnaires of Opinion to collect users' opinions about the web document design and structure and their orientation on it, path preference and involvement experienced, a Questionnaire on computer literacy and about user's motivation to participate in this study, and a final report about this study and their opinion about web courses for further learning.

As a pre-requisite for this study, subjects should be Portuguese Literature undergraduate students and they have had to read the novel "Cousin Basilio". Subjects received three packages along the course, containing instructions for the sessions on the web; knowledge tests: pre-test, intermediate test and post-test and Questionnaires of Opinion about the WWW course, and a Questionnaire on Computer Literacy.

When they finished the first package (Pre-test, Questionnaire on Computer Literacy), they contact the researcher for a session in the lab. This session intends to help subjects to feel comfortable to use and explore the web document. At the end of this session, students took the second package. As soon as they finished, the last package was sent to each one. Finally when they sent this one they received the questions for writing the final report.

Sample characterization

Twenty eight 3rd year undergraduate students enrolled in Portuguese Literature participated in this study. three males and twenty-five females, ranging from nineteen to twenty-seven years old. According to the information collected by the Questionnaire on Computer Literacy, we realized that most of the subjects (79%) never explored an interactive environment such as CD-I or CD-R. Only 12 subjects had explored the Internet. They mentioned different kinds of motivation for participating in this study, but the most referred ones were: to participate in a distance learning web course, to participate in this study due to their interest in literary work, or due to their interest in Eça de Queirós' literary work.

Results and discussion

We used non-parametric tests, specifically Mann-Whitney U test. The knowledge tests measure three kinds of transfer: self transfer or reproduction, near transfer and far transfer (Gick & Holyoak, 1987). The kinds of transfer that measure cognitive flexibility are near and far transfer. This last one is the most difficult and demanding kind of transfer.

Pre-test	CFT	NTC	Z corrected for ties	Statistical significance
Total	15.19	13.58	-.511	p=.6091 NS
Reproduction	14.59	14.38	-.071	p=.9434 NS
Near transfer	15.44	13.25	-.699	p=.4846 NS
Far transfer	14.48	14.04	-.260	p=.7951 NS

Table 2 - Pre-test statistical analysis (Mann-Whitney U test)

Pre-test results show that there is no statistically significant difference (p=.6091), the groups are similar before being submitted to treatment (table 2).

Intermediate test	CFT	NTC	Z corrected for ties	Statistical significance
Total	18.03	9.79	-2.62	p=.0087 S
Reproduction	14.75	14.16	-.186	p=.8531 NS
Near transfer	17.87	10	-2.51	p=.0121 S
Far transfer	18.12	9.66	-2.71	p=.0066 S

Table 3 - Intermediate test statistical analysis (Mann-Whitney U test)

During this study, students have done an intermediate test. Results pointed out to statistically significant difference achieved in the test ($p<.05$) as in near and far transfer questions. There is no statistically significant difference in the reproduction questions, perhaps because the knowledge to be applied to these questions was the same on both documents.

Post-test	CFT	NTC	Z corrected for ties	Statistical significance
Total	18.12	9.67	-2.69	p=.0071 S
Reproduction	14.50	14.50	0	p=1 NS
Near transfer	17.66	10.29	-2.35	p=.0189 S
Far transfer	17.12	11.00	-2.02	p=.043 S

Table 4 - Post-test statistical analysis (Mann-Whitney U test)

Post test results show that there is statistically significant difference (p=.043) that gives evidence to the development of cognitive flexibility on the group of subjects exploring the CFT web document. This result shows the importance of thematic commentaries on knowledge transfer to new situations (table 4). CFT group has better results in near and far transfer questions. As on the previous test, both groups achieved similar results in these question, p=1.

Most of subjects (66%) considered the session in the lab indispensable and 34% of subjects considered that the information available on "help" was clear enough to explore the document. In what concerns users' opinion about the web document, 58% considered it "accessible to use" and 42% considered it "easy" to learn to use. On the first session, most of them (58%) felt oriented in the web document and 37% felt disoriented; on the following sessions all feel oriented, excepted one subject who felt disoriented.

Most of them (84%) considered the reading proposed to the novel "interesting" and 16% considered it "acceptable". They mentioned that they (95%) felt actively involved in this learning process. Their preferred path is the deconstruction process (Cases).

Subjects' opinion about web courses for further learning is a positive one (74%), however some would prefer a combination of face-to-face meetings and distance learning.

Conclusion

The knowledge representation used in this study to promote cognitive flexibility gives emphasis to knowledge deconstruction and to thematic criss-crossing. This complementary approach to complex knowledge representation used by Cognitive Flexibility Theory led us to study what is the importance of "thematic commentaries" (this is the focus of the deconstruction process) in learning and in cognitive flexibility. Results give

evidence to the deconstruction process to develop cognitive flexibility, i.e., to the importance of "thematic commentaries" to knowledge transfer to new situations.

Although subjects' computer literacy was low they felt it was easy to use the web document and to navigate in. They liked its design and structure.

They are receptive to participate in web courses for further learning, but some would prefer a combination of face-to-face meetings and distance learning.

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Learning Science Concepts at a Distance in Preservice Teacher Education: Results of a Pilot Study

Christina Wotell Charnitski
College of Misericordia

Francis A. Harvey
Drexel University

Abstract

This paper will report the findings of the first phase of a multi-phased research project that is aimed at examining preservice teachers' development of science concepts when learning (a) takes place at a distance, and (b) is facilitated by videoconferencing technology. This study will build on the work that was done by Lansdown, (Lansdown, Blackwood, and Brandwien, 1971) and validated at Boston College (Trainor, 1978) and at Harvard University (Harvey, 1980) that demonstrated the validity, effectiveness and evaluative power of an investigation/colloquium approach to students' development of science concepts in a face-to-face learning environment. The pilot study investigated the use of the investigation/colloquium approach (a series of student-directed explorations with hands-on materials followed by colloquium discussions facilitated by an adult leader) by ten students at two sites connected by videoconferencing technology. Results of the pilot study, analyzed using standard qualitative analysis procedures, indicated that Vygotskian group socio-cultural learning (particularly the development of science concepts) could take place effectively when the groups are in separate locations connected by videoconferencing technology.

Introduction and Need for the Study

This paper reports the findings of a pilot study which was the first phase in a project designed to investigate and validate techniques for using videoconferencing technology to promote the development of preservice teachers' science concepts. The ultimate goal of this three-phased study is the development of a curriculum matrix (content, material, and procedures) that will facilitate science concept learning at a distance. The study will be used to examine the efficacy of using videoconferencing technologies to improve science concepts in preservice teachers by (a) supporting innovative course configurations that may increase preservice teachers' access to pedagogically sound science instruction, (b) extending professional collaboration between preservice and inservice teachers; and (c) promoting quality continuing education that is accessible and affordable.

The results of the Third International Mathematics and Science Survey (IEA, 1996; NSB, 1998) raised serious concerns about science education in the United States. The data collected from the TIMSS demonstrated that the U.S. science curriculum lacks focus and depth (NSB, 1998; Schmidt & Wang, 1999; Valverde & Schmidt, 1998). Schmidt and Wang (1999) stated:

One of the most salient and powerful policy implications from the TIMSS is the essential role of the curriculum in the teaching and learning of math and science. The TIMSS achievement results suggest a disturbing pattern: the relative standing of U. S. students compared with other countries declines from fourth to twelfth grade. The U.S. science curriculum over these same grade levels has been characterized as highly repetitive, lacking coherence, and not focusing on rigorous content as defined internationally. (online)

Schmidt and Wang suggested that the failure of the U. S. students in science may well be the consequence of "...the mile wide inch deep curriculum, the largest textbooks in the world, and a splintered vision of what children should learn about science." (online) They further noted that U.S. textbooks "...play a major role in the splintering or fragmenting that occurs in U. S. science education." (online) They argued that the problem with textbooks cannot be underemphasized since teachers in elementary or middle school who do not have strong science backgrounds view and teach science directly from the textbooks.

Research literature suggests that most U.S. elementary and middle school teachers lack the content knowledge and confidence needed to teach science (Berg, Huinker, & Neuman, 1993; Rice & Corboy, 1995) . According to Rutherford and Ahlgren (1990):

Few elementary school teachers have even a rudimentary education in science ... Unfortunately, such deficiencies have long been tolerated by the institutions that prepare teachers, the public bodies that license them, and the schools that hire them....

A revised curriculum is needed in both the content and the delivery of preservice science courses if we are to prepare teachers who have a firm understanding of the basics of science (AAAS, 1994; Berg et al., 1993; Harris, 1993; Tolman & Campbell, 1991).

Measuring learner achievement has been a major focus of studies in interactive video-based learning (Moore, Thompson, Quigley, Clark and Goff , 1990; Payne, 1997). A vast body of research literature generally acknowledges that there is no significant difference in learner achievement between students who participate in instruction at a distance and students who participate in traditional settings. Yet, the validity of this body of research has been called into question (Cohen, Ebeling, & Kulik, 1981; Moore et al., 1990; Phipps & Merisotis, 1999; Russell, 1996; Schlosser & Anderson, 1994). Phipps and Merisotis, 1999 stated that there is rising evidence that much of the existing research that has examined student achievement in distance learning is weak and largely anecdotal.

Most research on distance learning has treated learner achievement as an all-inclusive term that does not distinguish between higher and lower level thinking skills. Vygotsky (1986) identified concept development as the ability to (a) form linkages between concepts without reference to concrete or sensory impressions, (b) verbally define the concept in abstract terms, and (c) apply the concept to new situations which must be considered in abstract terms. Clearly, learner achievement that is a measure of concept development as defined by Vygotsky is far different than learner achievement that is a measure of lower level cognitive skills such as the student's ability to identify, order, or compare lists of items.

This paper will report the findings of the first phase of a three-phase study that was conducted in March-April 2000. The participants included undergraduate students from College Misericordia's Teacher Education Program who were enrolled in a science methods class. A unit on waves was taught using the investigation/colloquium model. Half of the students participated from the videoconferencing facilities at College Misericordia (Dallas, PA) while the other half participated from King's College (Wilkes Barre, PA).

Preliminary findings suggest that preservice teachers can learn science concepts at a distance when connected by videoconferencing technology using the investigation/colloquium method of instruction. Other preliminary data offer insights into procedural changes for the second phase of the study which will take place in September of 2000.

Method

A considerable body of literature (e.g., Lenning & Ebbers, 1999; Moller, 1998; Mukhopadhyay, 1997; Palloff & Pratt; Stone & Sulino, 1997) has suggested that a key element in successful distance learning is the formation of a synthetic class relationship. A synthetic class relationship is one in which the students come together as one cohesive community of learners. In a successful distance synthetic class relationship, students feel and act as part of one group whose members just happen to be situated in various geographical locations. The verbal and nonverbal socio-cultural interactions evident in a synthetic class relationship are consonant with Vygotsky's emphasis on the socio-cultural aspect of concept development. This pilot study was conducted in the late spring of 2000. The study was designed to extract information from the socio-cultural elements in the learning environment by focusing on the patterns of interaction between and among participants during the colloquium segments of each videoconferencing session.

The research took place at a small, private, four-year college in Northeastern Pennsylvania and included a baseline assessment of the participants and four one-hour videoconferencing sessions. The study participants included 10 volunteer preservice education majors who had completed their core science requirements but had not yet fulfilled their science methods requirement. Five of the students participated from the college videoconferencing facilities and five students participated from a videoconferencing facility approximately 10 miles from the campus. Students were designated as being same-site or other-site, which was determined by the physical presence or absence of the instructor.

The instructor was a physics professor who has a background in science education, and regularly co-teaches the science methods courses with a teacher education faculty member. During the study the instructor was physically present at each site for two sessions. Additionally, an activity aide was present at the other site (i.e., remote) who simply handed out materials and did not interact with the students during the sessions.

The study consisted of a baseline assessment and investigation/colloquium-based lessons that were facilitated by videoconferencing technologies. The baseline assessment consisted of a short one-on-one interview of the participants to establish their baseline knowledge of waves. Participants were asked an open ended question (i.e., "What can you tell me about waves?"), and a follow up question (i.e., Is there anything more you can tell me?) The participants exhibited wave concept understanding below an upper elementary level.

The experimental sessions were comprised of four one-hour investigation/colloquium sessions that were delivered using videoconferencing technologies. The first three videoconferencing sessions began with the instructor introducing manipulable materials that would allow the participants to physically explore wave phenomena. The materials used were: (1) slinkies; (2) string telephones; (3) oven racks suspended by strings. After the instructor introduced the materials, the students were given ten minutes during which they engaged in hands-on investigations using the materials. At the end of the ten minutes of investigation, the instructor called both groups together to participate in a fifteen-minute colloquium. The colloquia were student-directed, with the instructor merely acting as a facilitor to the discussion. The purpose of the colloquia was to have the participants discuss their observations and attempt to verbally make sense of their investigations. Among other things the colloquium participants asked questions, gained insights from each other, and came up with new ideas about how further investigation may help them find answers to their questions. Following the colloquium the participants engaged in another ten minutes of hands-on investigation, which was again followed by a fifteen-minute colloquium. During the final week, the session structure remained the same (i.e., ten minutes of investigation followed by fifteen minutes of colloquium) however, the participants watched video segments that demonstrated wave concepts instead of working with manipulable materials.

All session were audiotaped and videotaped. Written transcriptions were made from the tapes. Colloquium statements were analyzed using Harvey's (1980) scoring scheme. Verbal interactivity was analyzed by numerical occurrences relative to the directionality of the statement. Each statement was coded as: (1) a response to a statement from either the same site or the other site; (2) a statement directed to either the same site or the other site.

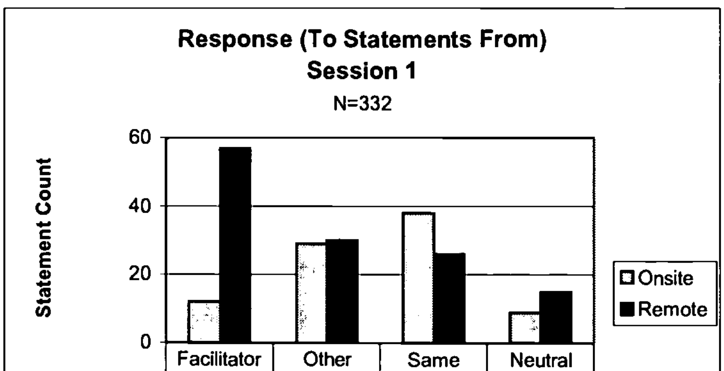
Results and Analysis

Informal analysis of the participants' statements from the colloquia associated with the hands-on investigations demonstrated that students at both the same-site as the facilitator and at the remote site developed higher-level concepts. The participants' statements were analyzed using Harvey's (1980) scheme, which is based on Vygotsky's levels of concept development. The statement analysis indicated an increase in students' higher level thinking statements (i.e., pre-concept) and a decrease in lower level thinking statements (i.e., complex) over the three sessions. In addition, the student's responses became more concise and focused as the sessions progressed and the total number of student statements decreased with each session.

Instructor (facilitator) statements also decreased over time which corresponded with a decrease in student statements directed to the instructor. Instructor statements accounted for 29% of the total statements during the first session and 8% of the statements in the final session. Total student statements (same-site and other-site) directed to the instructor (facilitator) decreased from 51 during the first session, to 26 during the second session, to one during the final session.

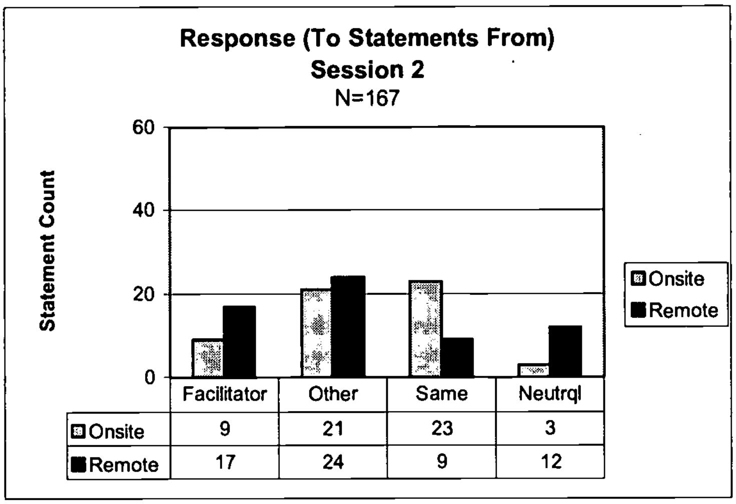
Extensive verbal interaction occurred both within sites and between sites, and the interactions between sites increased over the three colloquia. Figures 1 through 3 present the number and types of responses made by subjects during the three sessions to statements from the facilitator, from subjects at the other location, and from subjects at the same location. Figures 4 through 6 present the number and types of statements directed by subjects to the facilitator, to subjects at the other location, and to subjects at the same location.

Table 1



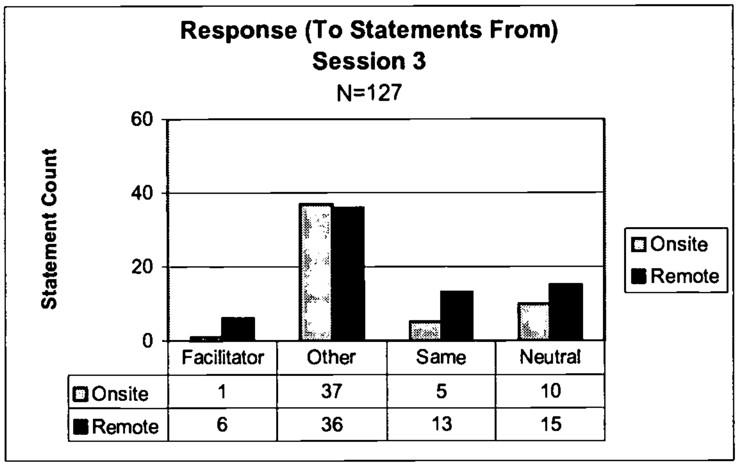
	Facilitator	Other	Same	Neutral
Onsite	12	29	38	9
Remote	57	30	26	15

Table 2

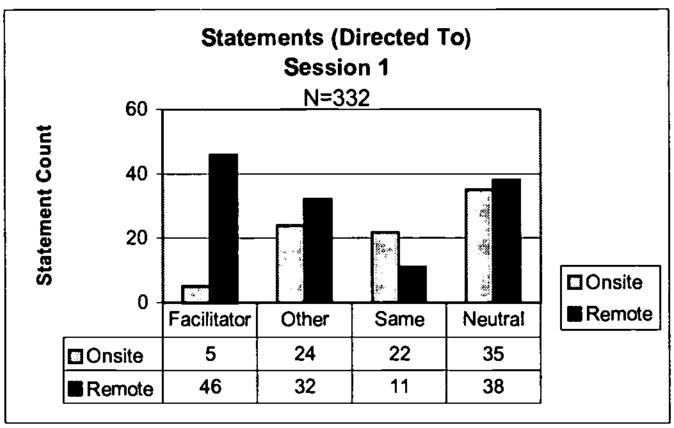


	Facilitator	Other	Same	Neutrql
Onsite	9	21	23	3
Remote	17	24	9	12

Table 3



	Facilitator	Other	Same	Neutral
Onsite	1	37	5	10
Remote	6	36	13	15



	Facilitator	Other	Same	Neutral
Onsite	5	24	22	35
Remote	46	32	11	38

Table 4

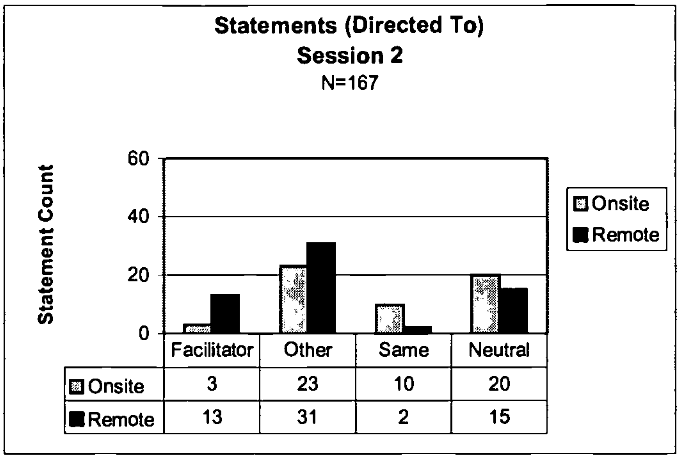


Table 5

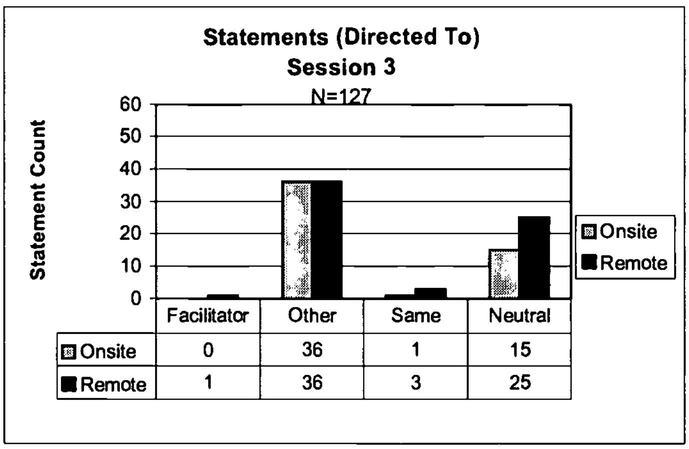


Table 6

Discussion

The main emphases of science reform appear to be consistent with Vygotsky's socio-cultural theory of learning. The initial findings of this study suggest that the unique characteristics of videoconferencing technology make it a promising medium for delivery of effective Vygotskian-based learning in teacher education. All indicators point to videoconferencing at both the studio and desktop level becoming more generally accessible, and therefore, more likely to be used in educational settings involving K-12 students.

Recently, the validity and reliability of much of the existing research on the use of videoconferencing has been called into question. This has left a paucity of reliable research that explains the phenomena related to teaching and learning via videoconferencing. Many critical questions remain unanswered. Further, the development of higher level thinking skills and concept formation is at the heart of the science reform recommendations; yet the existing body of literature fails to make a distinction between higher and lower level thinking skills as they relate to student achievement.

Videoconferencing and other distance technologies alter the classroom dynamics sufficiently to warrant a cohesive research effort that examines the mediating factors that affect student concept development when learning takes place at a distance. The results of this study suggest that the investigation/colloquium approach, which has proven successful in the traditional classroom, may be useful in videoconferencing learning. The final two phases of this research project will further test and refine the preliminary findings of this study.

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Formative Research on the Refinement of Web-based Instructional Design and Development Guidance Systems for Teaching Music Fundamentals at the Pre-college Level

Dr. Wen-Hao Chuang
Multimedia Innovation Center
The Hong Kong Polytechnic University

Abstract

Recent advancements in computer and Internet technologies enable universities to implement cost-effective Web-Based Instruction (WBI) and to provide open learning environments 24 hours a day, 7 days a week. While more and more WBI courses are continually being developed, little attention is being paid to effective, systemic, and systematic WBI design and development. Collis (1996) mentions "WWW-based course environments are rapidly appearing, before there has been time for much theoretical development with respect to guidelines for their design" (p. 26). Although there are some general guidance systems focused on WBI design and development process, much of the knowledge about these guidance systems is tentative and lacking in details. The purpose of this research, therefore, is to improve these guidance systems and to provide more detailed and useful guidelines in a special context.

This research first synthesized several general WBI design and development guidance systems. Next, the formative research methodology was used to improve that synthesis. A case was chosen for this study, the context being the teaching of music fundamentals at the pre-college level. Efforts were made to identify which guidelines were or were not useful in this case and which guidelines might be beneficial to modify, delete, or add in this context. Both on-site and online interviews, observations, and document analyses were conducted with all developers involved in this WBI project.

As a result of this study, the synthesized general WBI design and development guidance system was revised for best fit with this case. These revisions are the major findings of this research. Discussion of each guideline and a final summary of the results were also made. Recommendations for practitioners and future research directions were also discussed. This new guidance system was intended not only to guide future practitioners in this field, but also to provide a theoretical framework for future research and theory development.

Background of the study

The single case in this study is a project called "Music Fundamentals Online (MFO)." According to the MFO project director, the typical undergraduate core in music schools in the United States consists of a four- or five-semester sequence of parallel courses in music theory and in musical skills (dictation, sight singing, keyboard, etc.), followed by one to two years of music history.

	1st semester [Fundamentals]	2nd semester
Year 1 (Freshman)	Theory and Literature I (T151), Musical Skills I	Theory and Literature II Musical Skills II
Year 2	Theory and Literature III Musical Skills III	Theory and Literature IV Musical Skills IV
Year 3	Theory and Literature V Musical Skills V	
Year 4	History I	History II

Table 1: Core curriculums at a typical music school (Isaacson, 1998)

An important part of the core courses is prior mastery of music fundamentals. The term "music fundamentals" refers to knowledge and skills associated with basic music literacy. Typically it includes the ability to read treble and bass clefs, to write and identify scales, intervals, key signatures, and chords, and to know basic elements pertaining to music notation, rhythm, and meter. It also usually includes basic aural skills, such as recognition of intervals and chord types, the ability to write down simple pitch and rhythm patterns, and a limited

amount of sight singing. Although it is important to have basic music skills before entering music schools, many students entering college who plan to have music as their major lack mastery of these basic skills. Take Indiana University for example. The MFO project director pointed out that over half of the students beginning the core curriculum lack proficiency in this area. Other institutions report figures ranging from 20-80% with 50% being typical (Isaacson, 1998). These students, therefore, require remediation.

Removing this deficiency at the college level is very expensive for both students and music schools–US$420-$1300 per student per semester as of 1999 for tuition at Indiana University (depending on the residency status), plus textbooks and other costs. It is expensive for the music schools, too, because schools need to hire extra instructors and allocate educational resources (classrooms, musical instruments, equipment, and so on) for this course. It is, therefore, to the student's and to the school's advantage that students arrive on campus with a solid grounding in music fundamentals. As a solution to this problem, Indiana University has taken the challenge and is developing an innovative WBI remediation course (MFO) in the hope of replacing the present classroom-based music fundamentals course. Students who register in MFO will devote four to six weeks to complete the whole course online. Upon completion of the prototype, the MFO program will be available during the summer before students enter college/music schools.

Guidance Systems of WBI Design and Development

WBI is still in its infancy, and there is little research about WBI design and development guidance systems. A number of general-purpose guidance systems for WBI design and development, though general in nature and not usually intended for complex WBI courses, can illustrate both the trends and process involved. To limit the scope of the study, some guidance systems that focused mainly on GUI issues or product issues (e.g., Collis, 1997; Boyle, 1997; Harasim, Calvert, & Groeneboer, 1997; Hedberg, 1997; Santi, 1997; Dillon & Zhu, 1997; Horton, 2000) were intentionally omitted in this literature review because they are more product-oriented. Following are some of the general WBI design and development guidance systems.

Berge's Guiding Principles in WBI design

Berge (1998) first defines design as "planning the instructional programme events--building the blueprint to guide development and tryout" (p. 38). This definition is similar to Wien and Gunter's "design" stage of WBI (Wien & Gunter, 1998).

Berge also limits the scope of his WBI design guiding principles and excludes some of the guidelines for on-line moderating and teaching (more product-oriented). According to Berge (1998), rules such as "find unifying threads," "present conflicting opinions," and "a facilitator should encourage the participants to introduce themselves," are intentionally left out in his guiding principles as they are too narrowly focused on implementation and delivery of on-line teaching.

Berge (1998) made some key assumptions before presenting his guiding principles in WBI design. These key assumptions include:

- Learning is a lifelong process that is important to effective participation in cultural and economic life in a democratic society.
- Learning involves the development of a broad range of skills, knowledge, and, particularly, attitudes that can be and should be fostered in both formal and informal learning environments.
- Learning involves a social construction of knowledge. (Berge, 1998, p. 32)

He then listed eight guiding principles for WBI design and categorized them into three groups (Berge, 1998).

- **Pedagogical**
  - Define/describe and list the purpose(s) for each activity, level and type of social and instructional interactivity, and feedback that is desired.
  - Define the levels of teacher-control, guided-teacher-control, student control and group-control that are desired regarding each activity.
  - Density of content should be inversely related to the amount of synchronous communication within the Web-based educational learning environment.

- **Technical/support**
  - Recognize that while on-line environments such as the Web permit multiple-media, currently text and graphics are the easiest to use.
  - Use the principle of technological minimalism.
  - Adequate technical support and training for both student and instructor is essential.

- **Social**
  - An important goal of web-based learning is the creation of an environment of co-operation and trust among students and the instructor.
  - In general, synchronous communication is more expensive than asynchronous. Still, both synchronous and asynchronous modes of communication are important web-based tools in teaching and learning (Berge, 1998, p. 33).

First of all, among all of Berge's guiding principles, some of them seem to be rather descriptive and lack detailed instruction or action to tell practitioners what to do and how to do it. For example, the guideline "Density of content should be inversely related to the amount of synchronous communication within the Web-based educational learning environment" does not include further instruction about "how to do it." This guideline is also considered to be somewhat product-oriented, as a more process-oriented guideline would be "Analyze the density of content to be taught within the Web-based learning environment." The other descriptive guideline is "Recognize that while on-line environments such as the Web permit multiple-media, currently text and graphics are the easiest to use." Also, since this is a general-purpose WBI design guidance system, some of the guiding principles tend to be general or imprecise. For example, the second principle in the pedagogical group can also be an ISD principle and not specifically a WBI design principle. There are many different genres of WBI courses. Some WBI courses are more like on-demand CBI (Clark, 1996) or CMI delivered via the Web. Whether all WBI courses require social activities as Berge suggested (in his assumption) is debatable. It will be beneficial to improve these guiding principles in a specific context based on formative research.

Welsh's Event-Oriented Design (EOD) Model for WBI

As Welsh (1997) pointed out, "those designing instruction that uses the Web as the primary means of communication between class participants need instructional development models that take into account the current and future capabilities of the Web, as well as its evolving limitations" (p. 159). Welsh first mentioned that any instructional design model for WBI must meet the following criteria:

1. It must be systematic, and therefore useful as a standard online course development methodology.
2. It must be adaptable to different educational disciplines and to differing pedagogical orientations.
3. It must be technology independent, incorporating technologies in wide use for instruction, as well as new technologies such as the Web.
4. It must be useful in traditional contexts so faculty can recognize the benefits of the design approach in instructional contexts other than WBI (Welsh, 1997, p. 160).

According to Welsh (1997), the EOD model involves consideration of three elements that draw from the fields of distance education and instructional design. These three elements are "asynchronous vs. synchronous learning, specification of performance objectives and the determination of instructional strategies for meeting objectives, and specification of information technologies best suited to meet instructional goals in distance contexts" (p. 160).

In the EOD model, first a course is conceptualized as a series of individual modules. Each module is comprised of a series of instructional events, each of which results in students meeting specific performance objectives. In summary, designing for WBI using the EOD model involves the following steps:

1. Specify instructional goals and performance objectives of the course using traditional instructional design methods.
2. Sequence performance objectives and chunk them into a series of instructional modules, each of which results in students meeting objectives. While instructional modules need not be equal in duration or scope, parallel structuring can establish a comfortable rhythm for the students and instructor.
3. Divide each module into a series of instructional events
4. For each event, specify event types: full synchronous, limited synchronous, or asynchronous.
5. For each event, specify appropriate Web-based technology to enable the event. Care should be taken to choose only from Web-based technologies available to the instructor and all students.
6. For each event, develop Web-based content where needed and define procedures that ensure smooth completion of the event.
7. Engage in formative evaluation and pilot testing as necessary to verify that each event, as well as the course as a whole, is robust pedagogically and procedurally (Welsh, 1997, p. 162-163).

Although Welsh (1997) does not define what he means by "parallel structuring," according to this article (Welsh, 1997), he was referring to the sequencing and chunking of the course modules (e.g., similar sequencing

structure, duration, or scope for each instructional module). While Welsh's EOD model tries to model WBI after traditional classroom-based instruction, I agree with other scholars (Khan, 1997; Relan & Gillani, 1997) that WBI may have the potential to be more flexible and powerful (e.g., more individualized or personalized instruction) than traditional classroom-based instruction. Also, although ideally it would be great to have a guidance system that is adaptable to different educational disciplines and to differing pedagogical orientations, this is a goal that cannot be easily achieved. To be more adaptable to different educational disciplines and to differing pedagogical orientations, a guidance system sometimes tends to be more general and lack specifics and details for a certain context. The EOD model can also benefit from formative research and more case studies for further improvement.

Gibson and Herrera's Case Study

Gibson and Herrera (1997) did a case study "How to go from classroom-based to online delivery in eighteen months or less: A case study in online program development." They described how a traditional undergraduate classroom-based course was redesigned to online delivery and the several stages of design and development. This study provided the following recommendations (guidance) for the WBI design and development process:

1. Decide upfront if your goal is to simply put some courses online or to design an entire online program. If the former, the resources needed are much less. If you are not sure whether your faculty or administration or even your technical system will support an online program, start by developing a few courses and offering them to current students
2. Use an existing course of studies, hopefully one that you have had much success with so that you are not doing curriculum development and learning how to teach online at the same time.
3. Identify enthusiastic faculty champions right away. Faculty support is the most important element; you cannot succeed without it. We recommend that you choose only full-time faculty at the outset; bringing in outsiders will forever diminish the status of the program to "continuing education."
4. Allocate the financial resources to pay your faculty developers. Online development is very time consuming, and although you are providing new, marketable skills to the faculty participants, there is an opportunity cost to them.
5. Treat your developers as a team; hold frequent meetings. They need to share ideas and help each other stay focused. There is much frustration during the learning curve. Reinforce their work and recognize their accomplishments at every opportunity.
6. Make sure that technical support is readily available to faculty and students. This includes having the right software and hardware provided to faculty and, most importantly, having technical people ready to help the faculty whenever they may need it. Build in this same level of technical support for students when the classes begin.
7. Do whatever you can to assure that your university has an adequate online library. Students taking online classes are doing so for the freedom from logistical boundaries. The online library services, for example, provide students immediate access to a wide variety of full-text journals as well as e-mail, fax and regular mail access to everything else. (Gibson & Herrera, 1997, p. 5)

Compared to Berge's and Welsh's guidelines, Gibson and Herrera's guidelines are more detailed and specific, but also more situational. For example, if a WBI course is focusing on drill and practice (e.g., CMI delivered through the Web), it might not need to have an online library. Some of these guidelines (e.g., number seven) are also more product-oriented. These guidelines can benefit from further evaluation, and improvements can be made to provide more guidance.

This review of literature reveals that current guidance systems for WBI design and development are too general and lack detailed guidance. Some of the guidelines are also descriptive and do not offer detailed instructions about how to "do" it. For a practitioner who wants to create a WBI course in the context of music education at pre-college level, the general guidance systems reviewed above simply cannot provide sufficient guidance. Therefore, these general guidance systems can benefit from more empirical case studies for further refinement and improvement, especially for a specific context.

Methodology

Phase I: Synthesis of WBI Design and Development Guidance Systems

There were two phases in this study: an initial synthesis which focuses on theory creation, and formative research which focus on theory improvement. During the phase of initial synthesis, all of the guidelines from

different WBI design and development guidance systems were kept in their original form but were organized into four categories: technology, pedagogy, implementation, and others. Similar guidelines were also grouped together for easier comparison. The initial organization was suggested by one of the developers to facilitate the brainstorming process during the formal interview sessions. This organization later was revised (as suggested by Reigeluth) based on chronological order as we thought this would help the practitioners more.

Phase II: Naturalistic Formative Research Study and Rationale

The purpose of this phase was to try to suggest improvements for the synthesized guidance system based on the empirical evidence gathered in a single case study, the context being in the teaching of music fundamentals at the pre-college level. The formative research methodology was chosen. Formative research is a type of developmental research or action research that is intended to improve a design theory for instructional practices or processes (English & Reigeluth, 1996; Reigeluth & Frick, 1999). It was originally derived from formative evaluation, which has the primary goal of improving an instructional product while it is being developed in order to achieve the objectives for which it was designed (Beyer, 1995; Dick & Carey, 1996). Reigeluth and Frick (1999) further point out that "for an applied field like education, design theory is more useful and more easily applied than its descriptive counterpart, learning theory" (p. 633). The focus of formative research, therefore, is to improve a design theory (instructional theory) and to provide detailed prescriptive guidance.

Results

After comparing and triangulating the developers' comments with other data sources plus my own synthesis and observations, a revised set of guidelines was generated. This revised set of guidelines was then sent to each developer for further comments and elaboration. Some of these guidelines were shifted to different phases based on developers' further comments, but no new guidelines were added. The following guidelines are the final results. Note that "New" stands for new guideline generated from the formative research, "Mod" stand for modified guidelines (from original source), and "Orig" stand for original, unchanged guidelines.

[Analysis and Planning Phase]

- Evaluate all possible instructional solutions. (New)
  - Conduct a survey to see if other schools have similar instructional problems and see if they already found a good solution to the problem.
  - If other schools have found a good solution, evaluate their solution to see if it fits into your own situation. If no schools have a good solution, evaluate other possible solutions.
  - Justify the technologies or solutions you choose.
  - Analyze cost/benefit issues beforehand.
- Assess the readiness of the community. (New)
  - Make sure that the intended audience has the proper equipment and Internet connections to access the WBI course.
  - Make sure that the intended audience will accept WBI as an instructional approach.
  - Make sure that the host institution has the proper network infrastructure to support the WBI course.
- Secure in advance the financial resources to pay your developers. (Mod)
  - Develop a detailed budget to accurately anticipate costs.
- Get support from faculty members and other stakeholders. (Mod)
- Identify enthusiastic faculty champions right away, and get them involved with the project. (Mod)
  - Choose only full time faculty at the outset.
- Decide upfront whether to implement an entire course online or just selected lessons. (Mod)
- Use an existing course of studies for your curriculum development if possible. (Mod)
- Start by developing small modules and test them at early stages of development. (Mod)
- Conduct a task analysis, and list all required tasks in as much detail as possible. (New)
- Treat your developers as a team; hold frequent meetings. They need to share ideas and help each other stay focused. There is much frustration during the learning curve. Reinforce their work and recognize their accomplishments at every opportunity. (Orig)
- Make sure that the project director knows about current computer/web-based technology. If not, find an interface person who can explain things to the director and act as a bridge. (New)

- The project director should be one of the developers or part of the development team if possible. (New)
- Make sure that all developers are familiar with the content and have experience teaching with the content area if possible. (New)

[Design Phase]

- Write down your instructional objectives in detail and list resources required. (Mod)
- When possible, use an existing course as a model to develop your instructional modules to speed up the design process. (Mod)
- Conceptualize a course as a series of individual modules, with each module comprised of a series of instructional events. (Orig)
- Sequence performance objectives and chunk them into a series of instructional modules, each of which results in students meeting objectives. When possible, employ *parallel structuring* to help establish a comfortable rhythm for the students. (Orig)
- For each event, specify appropriate technology to enable the event. Care should be taken to choose technologies available to all students. (Mod)
- Create a safe, non-threatening, and reliable online learning environment for the learners.
  - Make sure the learners feel comfortable performing at an early stage of learning.
  - Use early encouragement and reassurance to help the learner feel comfortable about making initial mistakes.
  - Build up trust between learners and the online learning system. The system should be reliable enough so that students can trust the online learning technology and don't have to worry about losing their completed tasks.
- Engage in formative evaluation and pilot testing as necessary to verify that each event as well as the course as a whole is robust pedagogically and procedurally. (Orig)
- Define/describe and list the purpose(s) for each activity level and the type of social and instructional interactivity and feedback that is desired. (Orig)
- Define the levels of teacher/computer control, student control, and group control that are desired regarding each activity. (Mod)

[Development Phase]

- Build up a knowledge-sharing and proactive working culture and promote innovation in your development team. (New)
- Evaluate and choose adequate course authoring/development tools at early development stages. (New)
- Hire courseware developers who are familiar with the course authoring/development tools you choose. (New)
- Build a simple group Intranet to share design documents among team members. (New)
- Use an Instant Messenger program (or other communication tool) when necessary for better team communication. (New)
- Subscribe to or monitor newsgroups/listservs of the development tools you are using. (New)
- Make sure that staff engagement and commitment are happening in your team, as it is very important to the success of the WBI design and development process. (New)
- Use the minimum technology required to achieve the instructional objectives. (Mod)
- Keep the online media (e.g., multimedia files) size as small as possible. (Mod)
- Develop a sub-system in your WBI to capture each student's problem solving process. This sub-system should be able to: (New)
  - Keep a history of students' correct answers.
  - Determine if mastery has been reached. The mastery criteria can be made of three parts:
    - A minimum number of problems that must be attempted
    - A maximum history list length (often the same as minimum number of problems to try)
    - A minimum percent correct of the problems being counted.
- Test your prototype on multiple platforms and browsers at early stages of development. (N)
  - Be aware that web pages on different browsers and different platforms can look very different.
  - Identify any cross-platform compatibility problems as early as possible.

- Provide adequate technical support for students in a Web-based instruction environment. (N)
  - Provide email or telephone technical support to answer students' technical questions.
  - Build up a knowledge base for the most frequently asked technical questions.

Conclusions and Recommendations

Conclusions

It was not possible to examine all aspects of WBI design and development guidelines and generate a perfect guidance system by synthesizing several general WBI design and development guidance systems and analyzing empirical evidence in a single case study. Therefore, this study is just a beginning, and more studies are needed to further confirm and elaborate the findings in this study.

First, as Powell (2000) mentioned:

Choosing Internet technologies to deliver training should occur only after careful consideration of a number of factors. These factors include what is taught, who is taught, where the learning takes places, how the teaching is supported, and when the teaching takes place. (p. 1)

Schools that are interested in WBI should analyze every possible solution before making the decision, as WBI might not be the best solution in a lot of situations and learning domains. Most of the media choices are done not for instructional purposes, but for implementation purposes (Powell, 2000).

Every WBI needs to be supported by instructional theory. Kulp (1999) identifies three instructional models and relates each to the learning objectives for which it is best suited (see Table 2).

	Instructional Model	Learning Objectives	Learner Activity	Collaborative?
1	Instructor centered	Information transfer	Passively receiving	No
2	Learner centered	Skill acquisition	Actively interpreting, practicing, questioning, challenging, discussing	Yes
3	Learning team centered	Mental model change	Collaboratively creating new knowledge	Yes

Table 2: Instructional models and learning objectives (Kulp, 1999)

According to Kulp (1999), the most common genres in WBI courses are learner-centered topics. Students interact with material in the course web site in somewhat the same way they would with a computer-based training (CBT) self-study course (Kulp, 1999). They actively interpret information and experience in order to create new knowledge or build new work products of some type. Based on this assumption and Gordon's "Music Learning Theory," we can hypothesize that most of the guidelines supported by this case can also be useful in creating other skill-based WBI courses, although more research is needed to confirm this hypothesized generalization. For other skill-based pre-college remedial WBI courses, the guidelines provided in this study might also be useful.

Secondly, in this study, not many guidelines were rejected. This indicates that most guidelines were useful based on the empirical evidence for this case. Some guidelines were refined to better fit in with this context of creating a WBI course at the pre-college level. One of the major findings in this study is additional guidelines and further elaboration of the original synthesized guidance system in this specific context. Also, some "holes" in the original synthesized guidance system were found, and new guidelines based on the experience from this case study were identified to fill those holes. But note that in a single case, there can be no evidence for further generalization; therefore the results cannot be generalize beyond this case. Only hypothesized generalizations can be offered, as mentioned above.

Finally, As Reigeluth and Frick (1999) pointed out:

> It should be patent that the development and testing of design theories is not a one-trial endeavor. It is a matter of successive approximations. Such theories continue to be improved and refined over many iterations (p. 635).

Further studies are needed to further refine and elaborate the findings generated in this study.

Recommendations

The recommendations in this study fall into two categories: recommendations for future WBI practitioners and recommendations for further study. For developers, I recommend to apply guidelines supported by this study that best fit in with your own project and to apply them with caution. Even though I pointed out the contextual influence, and the elaborated and new guidelines in this study look promising, this is just one case study. For a single case study, generalization can't really be made beyond the context of music fundamentals instruction because of lack of other research to support those generalizations. Further studies are needed to confirm those findings before we really have confidence in their generalizability.

Further study is recommended to continuously elaborate and refine the WBI design and development guidelines for the context of teaching music fundamentals at the pre-college or college level. As this study only covered the design and development phases, there is still plenty of room for further elaboration and refinement in this context, especially to include guidelines for the implementation and evaluation phases. Secondly, I recommend future research to address other learner age groups and the content areas. For example, WBI might be a good solution/medium for pre-college or college learners, but how about younger or older learners? Also, how about other types of music courses such as music history or advanced music theory courses? Will the WBI design and development guidelines concerning these different content domains or age groups be different from the guidelines provided in this study? Further research in this area can help us get a sense of the generalizability of the guidelines supported by this study. Finally, the product of the MFO project--the WBI course--also needs some research. At the time of this writing, the MFO team was just about to start their larger-scale final beta testing of its prototype and will have more revisions in the future. So further formative research on the ongoing MFO project is highly recommended to generate product-oriented guidelines. This is an important part of my research agenda for the near future. Other recommended product-oriented research directions include:

1. Learning styles and WBI: Learning styles deal with characteristic styles of learning. Kolb (1984) proposes a theory of experiential learning that involves four principal stages: concrete experiences, reflective observation, abstract conceptualizations, and active experimentation. He also postulates four types of learners: assimilators, divergers, convergers, and accommodators. For example, Kolb (1984) points out that an accommodator prefers concrete experiences and active experimentation. Pask (1988) also has described two learning styles: serialist and holist. According to Pask (1988), serialists prefer to learn in a sequential fashion, whereas holists prefer to learn in a hierarchical manner. As WBI is more flexible and powerful in the way that it can provide more *individualized* or *personalized* instruction, it will be interesting to conduct research to investigate what kind of instructional strategies or approaches would be most effective in a WBI product and their relationship with different cognitive and learning styles.
2. Music aptitude and WBI: In the past, musical ability was often viewed in all-or-none terms: some are blessed with "talent," others must do without. Recent research (Gordon, 1993; Baney, 1999), however, reveals that music aptitude, like all human characteristics, is normally distributed in the population. Relatively few have high aptitude, a similar number have low aptitude, and the majority of persons fall somewhere in the middle of the "bell curve" with average aptitude. In another words, most persons have the potential to achieve in music. It will be interesting to see how people with different music aptitudes interact with Web-based courses such as MFO. More research is recommend to find out the relationship between music aptitude, music learning theory (Gordon, 1997), and WBI.

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Concept Learning Through Image Processing

Lauren Cifuentes
Yi-Chuan Jane Hsieh
Texas A&M University

Abstract

This study explored computer-based image processing as a study strategy for middle-schoolers' science concept learning. Specifically, researchers examined the effects of computer graphics generation on science concept learning and the impact of using computer graphics to show interrelationships among concepts during study time. Educators are encouraged to prepare learners to use computers to visualize concepts during study time. An orientation to visualization skills can prepare students for using visual techniques to represent interrelationships among concepts.

Background and Theoretical Perspective

Computer graphics software such as AppleWorks™ and PhotoShop™ have become pervasive in today's schools. Such software allow students to access a variety of tools that help them draw and paint objects to visually organize and represent what they know. Student-generated interpretative illustrations can help clarify the profound concepts expressed in texts and facilitate the comprehension of abstract concepts. When students are able to manipulate images during knowledge construction, they tend to engage more in the meaning-making process and understand and remember concepts better than through the traditional transmission approach of instruction (Jonassen, 2000). Additionally, students' graphic representations of what they know, can provide products for teacher feedback.

One approach for knowledge construction commonly used by students is concept mapping (Anderson-Inman & Ditson, 1999). Concept mapping refers to the "process for representing concepts and their relationships in graphical form, providing students with a visually rich way to organize and communicate what they know" (p.7). Research has suggested that students can study efficiently by generating concept maps (Anderson-Inman & Zeitz, 1993). Also, Cifuentes (1992) found that students who visualized interrelationships among concepts in their hand written study notes performed significantly higher on a test ($p= .02$) than those students who did not show such interrelationships. Concept mapping can be fostered through computer-based software such as Inspiration™. Additionally, images can be manipulated to show interrelationships with image-processing software such as AppleWork's™ drawing and painting tools. These visualization tools can be regarded as "mindtools" to extend and reorganize learners' cognitive structures during learning (Jonassen, 2000). Learners can use graphic conventions for organizing their thoughts as they construct knowledge of concepts (Dodge, 1998). Computer-generated graphics created by learners offer several advantages over pen and paper such as ease of subsequent revision and generation of sophisticated looking graphics by students with undeveloped artistic skill.

Objectives

This study explored computer-based image processing as a study strategy for middle school science concept learning. Specifically, researchers examined the effects of computer graphics generation on science concept learning and the impact of using computer graphics to show interrelationships among concepts during study time.

Methods

The 87 students engaged in this study were volunteers taking junior high school science classes at a rural, public, junior high school. They had previous skill with AppleWorks™ draw and paint software.

Quantitative and qualitative methods were used to investigate the research topic. Potential participants were the entire 7th and 8th grade student body of a rural school in Texas. However, some of those students did not turn in consent forms, some were absent for part of the treatment, and others were absent for testing. Therefore, 87 students participated in the complete study. Science classes were randomly divided in half from both the seventh and eighth grades so that approximately half of the student body were assigned to the control group (n= 46) and approximately half of the student body were assigned to the experimental group (n = 41). The groups were comparable across age, gender, and ethnicity. The control group consisted of 50% seventh graders and 50% eighth graders. 59% were male

and 41% were female. 54% percent were Caucasian, 24% percent were African-American, and 22% percent were Hispanic. The experimental group consisted of 44% seventh graders and 56% eighth graders. 49% were male and 51% were female. 51% percent were Caucasian, 34% percent were African-American, 10% percent were Hispanic, and 5% identified themselves as a mixture of races. Participants were assigned to one of two groups, one receiving treatment and one for control, in a post-test-only-control-group design. Posttest scores were compared across groups. In addition, student's study strategies were compared qualitatively to help explain the impact of graphics on learning. The four data sources included: (a) immediate recall test, (b) students' study notes, (c) students' computer files, and (d) a Web-based "Study Strategies Questionnaire".

Quantitative aspect: All participating science courses were placed in a hat and drawn to randomly assign them to the two treatment groups:

- **Control group**-- received print-based, verbal material on a science concept (General Properties of Matter) and were given 50 minutes for unguided, independent study prior to the test. Students had access to computers during study time. At the end of the 50 minutes students kept both their study notes and reading material. The next day, and prior to taking the test, students handed in their study notes.
- **Experimental group**—participated in a workshop consisting of three 50-minute training sessions on how to manipulate and generate computer graphics during study time using materials developed by the researchers in AppleWorks™, Photoshop™, and PowerPoint™. They then received the same print-based, verbal material that the control group received. It was on a science concept (General Properties of Matter) and students were given 50 minutes to study prior to a test. At the end of the 50 minutes students kept both their study notes and reading material. The next day, and prior to taking the test, students handed in their study notes.

The three 50-minute workshop sessions on how to manipulate and generate computer graphics during study time had the following objectives: for students to be able to (a) recognize underlying structure of text (interrelationships), (b) illustrate underlying structure, (c) relate new concepts to prior knowledge, (d) highlight distinctive features, and (e) use graphics for review. The researchers facilitated the workshop. They modeled visualization of concepts using 7 underlying structures, gave the students a turn with each of the 7 underlying structures, modeled direct representation of concepts and highlighting distinctive features, gave the students a turn with direct representation and highlighting, and gave students 15 short texts to visualize. They encouraged students to keep their graphic representations and use them for study and review.

After taking the immediate recall test, participants filled in a Web-based "Study Strategies Questionnaire" that asked them to rate the extent that they had previously been exposed to the information in "General Properties of Matter?" To determine if groups varied in their prior knowledge of the textual material, a t-test was conducted. No difference was found. The questionnaire also asked students to describe in detail the steps that they took to prepare for the test. The testing instrument for immediate recall contained 30 multiple-choice items. All students took the immediate recall test at the end of their 50-minute study to determine the effects of the experimental treatment.

In addition, all participants' study notes and printouts of computer graphics were collected. Participants were asked on the Web-based survey to describe in detail the steps that they took to prepare for the test. The researchers rated the participants as visualizers or nonvisualizers based upon the students' study notes and study strategies reported on the survey. We classified students as visualizers if they used the computers to construct visuals while they studied for the test and/or reported that they hightlighted or drew while they studied. We classified students as nonvisualizers if they did not create visuals or highlight during study. The effects of treatment and application of visualization during study time on immediate recall were then estimated by comparing scores using planned contrasts in a general linear model.

The design avoided effects of initial bias, previous testing, maturation, instrumentation, regression, selection, and mortality because groups were randomly assigned and were not pretested.

Qualitative aspect:

We applied content analyses approaches, as described by Emerson, Fretz, and Shaw (1995), to the study notes, computer files, and survey results. During and upon completion of data collection, we used the two-phase process of content analyses, open coding and focused coding.

Results

The ANOVA revealed a negative treatment effect. The control group performed better than the experimental group and there was no statistical difference between the scores of visualizers and nonvisualizers. In addition, there was no interaction between group and strategy on students' performance.

In this case, computer-based image processing was not an effective study strategy for science concept learning. Middle school students were unable to identify or represent underlying structure. They claimed that visualization was too hard for them and they expressed lack of motivation. They were distracted by the computers and the fun software and were distracted by graphics tools. They spent their time creating irrelevant images and generated visuals that involved inefficient use of time.

The students who received the workshop in visualization as a study strategy did not perform better on the test on "The General Properties of Matter. Several environmental factors affected the impact of the workshop. Workshop time was insufficient and students had difficulty internalizing the visualization as a study strategy while they studied. Students were unable to manage their time for studying the entire text and meanwhile draw meaningful visuals to foster their understandings.

In addition, the students who visualized concepts while studying did not perform better on the test. They often spent time visualizing what they already knew rather than grappling with a new concept. The visuals generated by students were often inappropriate or misrepresented concepts and therefore could not facilitate concept learning (see Tables 1 and 2).

Table 1
Descriptive Statistics for Groups

Group	**Strategy**	Mean	Std. Deviation	**N**
Control	**Nonvisualizers**	14.11	5.48	36
	Visualizers	14.00	4.57	10
	Total	14.09	5.25	46
Experimental	**Nonvisualizers**	10.33	4.56	18
	Visualizers	13.30	3.30	23
	Total	12.00	4.13	41
Total	**Nonvisualizers**	12.85	5.45	54
	Visualizers	13.52	3.67	33
	Total	13.10	4.84	87

Table 2
ANOVA for Effects of Treatment and Visualization

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Group	88.230	1	88.230	3.996	.049*
Strategy	36.061	1	36.061	1.633	.205
Group * Strategy	41.883	1	41.883	1.897	.172
Error	1832.425	83	22.077		
Total	16954.000	87			

R Squared = .091 (Adjusted R Squared = .058) * significance $p \leq .05$

We delivered the workshop in a naturalistic, rural school setting. Therefore, many unexpected environmental occurrences affected the delivery of the workshop. For instance, we encountered electrical failure in the projector, and were unable to model visualization processes on the presenter computer. We had to adopt "plan B" and use overhead transparencies. Of course, this meant that we were unable to model using graphics tools for visualization. All during the workshop, electricians and teachers came in and out of the computer lab to address the technological problems, or students would ask to go to get water or go to the restroom. Some students talked and visited with each other rather than focus on learning and some did not participate in parts of the workshop because of illness, extracurricular activities, or loss of interest. Additionally, the arrangements of the projector and students' workstations (chairs, tables, computers) were so inharmonic that students' positions had to shift to look at the presenter, projected images, and their computer screens alternately. Furthermore, because several computers in the lab were out of order, many students had to share computers with each other. Similarly, access to printers was limited. Only four out of the twenty computers were connected to the classroom printer, which made the preservation of students' work difficult. Students could not incorporate Web graphics into their visualizations because none of the computers were connected to the World Wide Web.

Moreover, the middle schoolers were extremely distracted by the software on the computers, especially the multimedia authoring software. Students tended to easily create sounds and irrelevant images on their computers. In addition, the 7th and 8th grade students spent a lot of time generating playful graphics or visuals that did not help them build their understandings. They did not make good use of their time for studying the entire assigned text. They tended to take the fun and easy route by visualizing what they already knew rather than grappling with a new concept. Several students said that they found identifying the underlying structure of the text to be quite difficult and we found that most students were often unable to create appropriate representations of new concepts. Most students were either unwilling or incapable of thoroughly and accurately representing texts. When, for instance, they were asked to represent the periods included in the Mesozoic Era, one student neglected to draw arrows in her timeline to indicate continuity and did not include the Mesozoic Era in her graphic. She also placed the periods in the wrong order on the timeline indicating her lack of understanding (see Figure 1). Another student misrepresented the visual of an iceberg. He was enthusiastic about drawing an iceberg, but ignored the text's main idea that only a small part of an iceberg is above the waterline and the rest of an iceberg is under water (see Figure 2).

Text to visualize: The Scientists divide the Mesozoic Era into three periods.
The oldest period is called the Triassic Period. The middle period is called the Jurassic Period. The youngest period is called the Cretaceous Period.

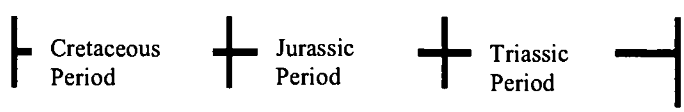

Figure 1. The misrepresentation of chronological information.

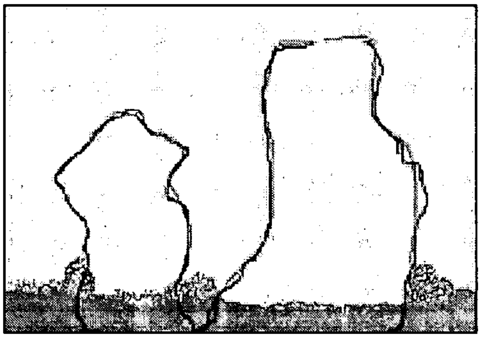

Figure 2. The misrepresented concept of icebergs.

On the other hand, some workshop participants successfully identified and visualized the underlying structure of the text they were studying. For instance, most students were able to successfully represent the sequence of the moon phases as well as chronology of periods within eras. Also, many students were able to directly represent concepts. For instance, one student generated a direct representation of how the earthworm breathes (see Figure 3).

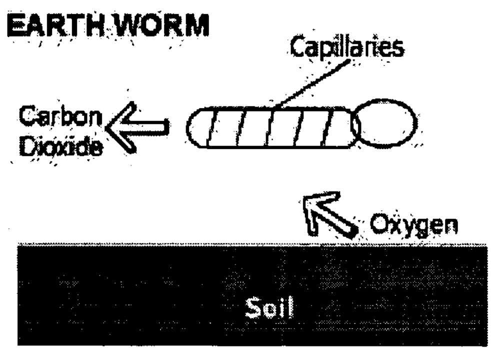

Figure 3. Student-generated visualization of the earthworm's respiratory process.

In general, the processes of identification of the underlying structure of concepts presented in texts and subsequent creation of visual representations associated with those concepts required a lot of time and effort from students. Such strategies facilitate memory because they involve the learner at a high level of cognitive processing by demanding extensive learner-effort. The visualization process helped most of our participants think hard about what they needed to learn, and learning that was not measured on the test resulted from such thinking. When students were able to extract meaning from text and generate representative images, they built their complete understandings. For example, as one student tried to understand that weight of an object changes according to altitude, but that mass remains the same, he generated a computer graphic accurately conveying an object with the same mass on a mountaintop and in a deep mine. Such kinds of visualizations concretized what students cognitively comprehended, and helped them clarify meaning of science concepts (see Figure 4).

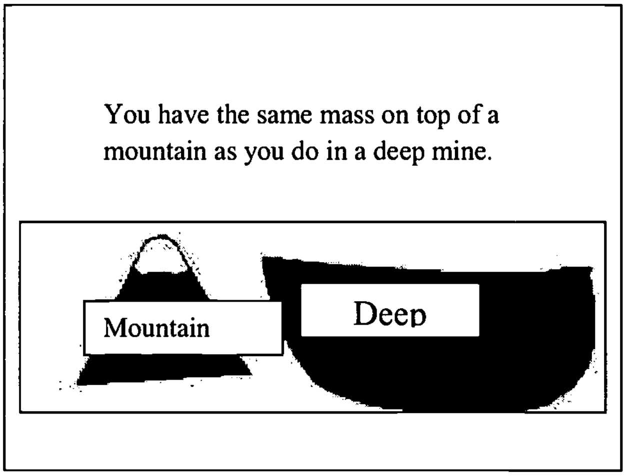

Figure 4. Student-generated computer graphic

Educational Significance

We discovered that learner generated graphic representations of concepts provided a rich resource for the students' teachers. Representations of learner's understandings provided teachers with a way of knowing whether or not students grasp concepts. Teachers suggested that if students can not visualize the concept, perhaps they don't thoroughly understand the concept.

In summary, we delivered a visualization workshop designed to help learners use computer graphics to construct meaning while they study. When delivering visualization workshops in the natural setting of schools, problems are bound to arise. Technical failure, human interruptions, lack of active participation, limited access, distraction by alternate tools or games on computers, and differences in learners' abilities each affect the success of a workshop. Middle schoolers are unsophisticated learners and require guidance toward effective visualization. In our workshop, in spite of problems associated with the natural setting of a school, students engaged actively in the meaning-making process of studying while we provided scaffolding. Students who successfully formulated mental representations of concepts and then concretized those representations as computer graphics applied a strategy for spending time thinking in order to learn.

Still, they require cognitive apprenticeship and expert modeling of identifying the underlying structure of concepts. Given the 3-day workshop, students were unable to internalize the visualization methods as part of their study strategy. Most students were cognitively not ready to generate meaningful computer graphics while they study the textual information. They were more likely to highlight the important points by typing those words or sentences on computer than producing visuals concretizing those concepts. Middle schoolers might need extensive practice in constructing their own concept representations while receiving expert feedback regarding their appropriateness

The 7th and 8th grade students who participated in our workshop were not sophisticated visualizers. They needed expert modeling of identifying underlying structure of texts. It is essential to have all students engaged in the diverse practice of constructing their own concept representations while receiving expert feedback regarding their appropriateness. Additionally, the instructor should teach students in the sequence of increasingly complex tasks. When the learning task becomes more and more difficult for students to handle independently, the aids of peers and the close scaffolding of the instructor are of great importance.

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A Connectionist Model of Instructional Feedback Effects

Roy B. Clariana
Pennsylvania State University

Abstract

This experimental investigation provides empirical support for the potential of a connectionist approach to predict instructional feedback effects. Posttest data from high school students is compared to values predicted by the delta rule. Results and implications are provided.

Learning involves the interaction of information provided by instruction with existing information already in the learner's memory (Ausubel, 1968; Bruner, 1990). When a learner commits to a lesson response, that response reflects the learner's immediate understanding of that instructional instance, thus initial lesson response (ILR) provides a measure of a learner's existing information.

Describing what happens to memory traces of ILRs that are errors is necessary for determining whether errors interfere with attaining correct responses, and so is one key to understanding how feedback works. Clariana (1999) has suggested that a connectionist approach using the delta rule can be used to predict posttest memory activation levels of ILR errors and of correct responses for immediate and delayed feedback. This investigation provides data that supports his approach. But first, what is a connectionist approach?

Connectionist Description of Feedback Timing Effects

Connectionist models apply various mathematical rules within neural network computer simulations in an effort, among other things, to mimic and describe human memory associations and learning. The theory includes several families of models, such as simple feedforward networks, pattern associators, multi-layer networks with backpropagation, competitive networks, and recurrent networks, that differ slightly in how the nodes of the network are interconnected, but which differ greatly in the kind of processing that they are able to do (see McLeod, Plunkett, & Rolls, 1998, for more detail). Neural networks have been shown to be capable of pattern matching, pattern completion, retrieval by content, recognition, prototype extraction, and classification to name a few (Haberlandt, 1997).

For example, Seidenberg and McClelland (1989) trained a computer neural network to read aloud all English monosyllabic words (about 3,000 words). After 250 training epochs, the model could correctly pronounce 97% of the 3, 000 words in the training set. This neural network was able to accomplish this task without a local lexical store and more importantly without being given a set of rules. Elman (1993) trained a neural network with sentences rather than words, and was able to show that the network could satisfy long-distance grammatical dependencies (matching syntax). Plunkett and Marchman (1993; 1996) have modeled early lexical development which parallels that observed in children. Their neural network model that produces past tense forms of regular and irregular verbs has challenged the language acquisition orthodoxy that language learning depends on both innate pre-wiring of the system and on learning symbolic rules of the language.

Among a number of connectionist learning rules, the delta rule (Shanks, 1995; Widrow & Hoff, 1960) is one of the simplest and most common that includes the effects of feedback on learning. The delta rule describes the change in association weight, termed Δw, between an input unit and an output unit at each learning trial, as:

$$\Delta w_{io} = \alpha\, a_{in}\, (t_o - a_{out})$$

where α is the learning rate parameter, a_{in} is the activation level of input units, t_o is the desired response (the t refers to "teacher", in this case t_o is item feedback), and a_{out} is the activation level of the output units (Shanks, 1995). In instructional terms, learning is an increase in association, that is, an increase in Δw_{io} between the stimulus (a_{in}) and the correct response (a_{out}); with a relative decrease in association, that is, a decrease in Δw_{io} for incorrect responses.

To apply the delta rule in this study, following Clariana (1999), this investigation assumes that lesson average item difficulty values are reasonable estimates of the association weights of the correct responses. Item difficulty (p) is defined as the proportion (p_g) of individuals who answer an item (g) correctly (item difficulty notation convention from Crocker & Algina, 1986). For example an item difficulty of .20 indicates that 20% of the learners responded correctly to that item. Item difficulty values range from 0.00 to 1.00 with low values indicating difficult items and high values indicating easy items. Using lesson average item difficulty values as a group's estimate of the initial lesson item a_{out} association weight seems reasonable in that lesson item difficulty is the actual averaged probability of selecting that alternative as the correct response during the lesson for that population of

learners. To our knowledge, this is the first investigation to utilize lesson item difficulty values as a measure of input and output activation levels.

In the delta rule equation, feedback impacts learning in the term (t_o - a_{out}). Customarily, the values for t_o and a_{out} are constrained between 0 and 1 (McLeod, Plunkett, & Rolls, 1998). The value for t_o equals 1 if the activation level of the output unit matches the desired response (i.e., with correct responses) and t_o equals zero if the activation level of the output unit does not match the desired response (i.e., with incorrect responses). So with correct responses the association weight increases since (1 - a_{out}) is positive, while with incorrect responses the association weight decreases since (0 - a_{out}) is negative.

In other words, when feedback is provided as part of the responding instance, correct responses are strengthened and incorrect responses weakened. The amount of increment or decrement can be determined by the delta rule. Thus, given lesson item difficulties (initial a_{out}), the delta rule should be able to predict posttest item difficulties (a_{out} after feedback). What values would the delta rule provide for ILRs for immediate and for delayed feedback? In the present investigation, first the delta rule would predict that for correct lesson responses, memory of ILRs and of correct responses would be strengthened in general for both immediate and delayed feedback, since t_o = 1 and so (t_o - a_{out}) is positive. Second, for lesson errors, the ILR association with the item stem would be weakened for immediate feedback since $t_o = 0$ and (t_o - a_{out}) is negative, but not for delayed feedback.

For delayed feedback, the connectionist model would predict that ILR errors would actually be strengthened. In associative learning in living systems, there is a small window of time while the specific input pattern is activated lasting probably less than 4 seconds (Shanks, Pearson, & Dickerson, 1989) when those associations can be strengthened or weakened. Immediate feedback provides the necessary teacher feedback information within this time frame while delayed feedback does not. Specifically, with delayed feedback, since corrective feedback is not immediately provided, the learning rule association process would act as though the error response is correct, thus strengthening the association weight of the error (see Figure 1).

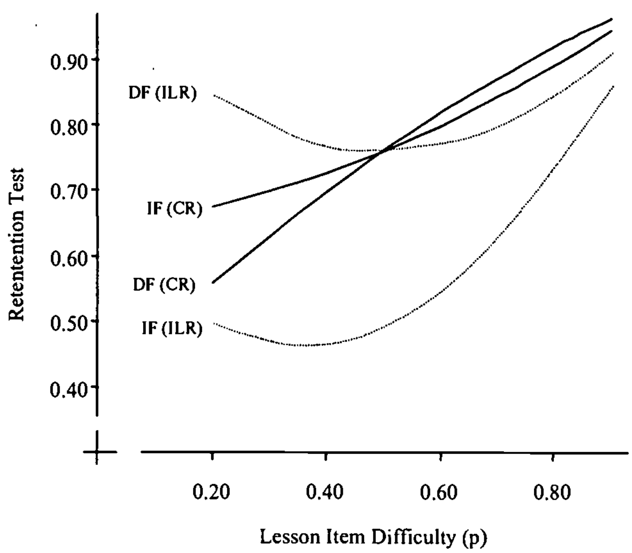

Figure 1. Predicted retention test values generated by the delta rule across a range of lesson item difficulty values (from Clariana, 1999). Predicted retention test memory of Initial Lesson Responses (ILR) are shown as dashed lines and Correct Responses (CR) are shown as solid lines for delayed feedback (DF) and immediate feedback (IF).

Based on the connectionist model of feedback timing described by Clariana (1999), several hypotheses can be stated: (1) Retention test memory of ILRs will be considerably greater for delayed feedback than for immediate feedback at all item difficulty levels (see dashed lines in Figure 1). (2) Both types of feedback will obtain the greatest lesson to posttest gain with difficult lesson items. (3) Retention test memory of correct responses will vary across the range of possible lesson item difficulty values for the delayed and immediate feedback forms, with immediate feedback slightly better than delayed feedback with more difficult lesson items and delayed feedback slightly better than immediate feedback with easier lesson items (see the solid lines in Figure 1).

In addition, it may be possible to separate any observed effects of immediacy versus multiple-exposures by including a type of feedback, multiple-try immediate feedback (MTF), which has aspects of both (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Clariana, 1993). MTF is like the more common form of immediate feedback (single-try feedback, STF) in terms of immediacy of feedback timing. But in terms of multiple explicit stimulus exposures, multiple-try feedback is like delayed feedback (DF), at least with lesson errors.

Method

The available sample for this study included students from three high school social studies classes (n= 87) from a small town in a northeastern state. The students were mostly sophomores, with a few juniors. A number of students chose not to participate, some were absent, a few forgot to return their signed consent forms, and three students' data were dropped due to incomplete data, yielding a final sample of 52 students. The final sample contained more females (71%) than males.

The computer-based lesson material consisted of eight reading passages and 36 five-alternative multiple-choice questions from the Nelson-Denny Reading Test, Form E (Brown, Bennett, & Hanna,1981; with permission of the publisher). These text passages and questions were chosen based on the quality of the text and questions, their high reliability, the availability of extensive test reliability metrics, and content appropriateness for this audience. Field trials by the developers involved more than 14,000 students (Brown, Bennett, & Hanna, 1981). Currently, these materials are extensively used in the field and are readily available from the publishers.

The 36 questions consisted of 18 verbatim questions and 18 inferential questions, similar to Peeck and Tillema (1978). Verbatim questions relate directly to one proposition in the instructional text. For example, the text may say, "Daytimes Robert Browning walked with Elizabeth's little dog Flush, but he seldom could be lured from his home evenings", with the associated verbatim question, "Flush was the name of the Brownings': A. cat B. dog C. canary D. gold fish E. thrush?". Inferential questions relate to multiple propositions in the text and can be answered by considering the passage as a whole. For example, the inferential question, "The authors of this passage placed most attention on the Brownings: A. literary efforts B. personal relationship C. social contacts D. problems E. early meeting?", can be answered by considering the entire passage. Thus, inferential questions have many indirect connections to the instructional text, while verbatim questions have one or only a few direct connections to the text.

The computer-based lessons were developed in HyperCard and delivered on MacIntosh computers. The three alternative computer-based lessons were identical except for the type of feedback that was presented after the learner responded to multiple-choice questions. For all treatments, each of the eight text passages was presented in turn in scrolling text windows. After reading a text passage, the learner would respond to either four or eight five-alternative multiple-choice questions (the longer passages had more questions). The learner would then proceed to the next text passage reading the text and answering the questions at his or her own pace. Simple navigation buttons along the bottom of every screen allowed the learner to easily move back and forth between text and questions at any time.

The three alternate treatments were delayed feedback (DF), single-try immediate feedback (STF), and multiple-try immediate feedback (MTF). Note that since retention test memory of initial lesson responses is a dependent variable in this study, in order to prevent rehearsal of initial lesson responses, the final feedback screen for each item in all three treatments did not include item distractors (Sassenrath & Yonge, 1969; Sturges, 1969).

The STF treatment provided the correct response immediately after one learner response, whether the response was right or wrong. After a response, an arrow would point to the correct alternative and the learner was told "Right" when correct and "No, here is the answer" when wrong. In either case, the stem and correct answer were displayed, the item distractors were not shown. The MTF treatment provided the correct response immediately after a correct response like STF. However, with an incorrect response, the learner was told "No, try again" and continued to select answers until the correct response was selected, then an arrow would point to the correct response and the learner was told "Right". Then the stem and correct answer were displayed, the item distractors were not shown. Note that STF and MTF are identical when the learner's initial response is correct, but obviously differ when the learner's response is incorrect. The DF treatment required the learner to respond to questions and

move on without any immediate feedback. After all text passage and questions were completed, then all of the items were presented again in the original order. Only the correct responses were shown with each question, the distractors were not shown, and the student could only read the display. Thus the DF feedback screen displays were identical to the final feedback screen displays provided for STF and MTF, only the DF feedback screen displays were presented after the entire lesson rather than immediately with each item.

The purpose and requirements of the study were explained in three classes of students all taught by the same teacher. Those students choosing to participate collected consent forms to be signed by a parent or guardian. About a week later, participants moved to the school computer room during their social studies class, and were randomly assigned to one of the three computer-based treatments, STF, MTF, or DF. One day later, participants completed the paper-and-pencil 24-hour retention test in class.

The retention test given a day after the lesson was designed to measure memory of initial lesson responses and of the correct responses. This paper-based retention test used the same 36 multiple-choice items that were used in the computer-based lesson. These 36-items fell into two groups of 18 items each, verbatim and inferential. These two groups were further blocked into three categories by lesson item difficulty, easy ($\underline{M}$ = .87), mid-range ($\underline{M}$ = .72), and difficult ($\underline{M}$ = .50), with each block containing six items. The associated reading passages were not made available to the students during retention testing. There were four or five questions on each 8.5- by 11-inch page. Each question had two blanks, one blank labeled "1st" for the initial lesson response and one blank labeled "C" for the correct response.

The retention test contained the following instructions, "Note that each question has two blanks. The first blank is a check to see if you can remember the first answer that you gave during the computer lesson. The second blank is for the correct response to the question." These instructions were read aloud by the teacher. The teacher answered questions about how to complete the test, and then students were given as much time as needed to finish.

The total amount of time spent completing the lesson was also of interest. Lesson time data for each student was collected by the computer program, and included total time from the display of the first screen until the student exited the lesson.

Results

Dependent variables were lesson time, and retention test recognition memory of initial lesson responses and of correct responses with two kinds of questions (verbatim and inferential) across three levels of lesson item difficulty (difficult, mid-range, and easy). These data were analyzed by separate analysis of variance, and probabilities were evaluated more conservatively using Greenhouse-Geisser and Huynh-Feldt corrections automatically provided by the SYSTAT 8.0 (1998) analysis package. Lesson time data and retention test means and standard deviations for each treatment group at each item kind and difficulty level are provided in Table 1.

Lesson scores were analyzed as a check of initial group equivalence. The random assignment was judged successful with overall lesson scores of 24.4 (of 36 maximum) for the STF group, 25.4 for the MTF group, and 25.5 for the DF group. The comparison of these means using analysis of variance was non-significant, $\underline{F}(1, 51) = 0.43$, $\underline{p} = .65$.

Retention test data were analyzed by a mixed 3 x (2 x 2 x 3) analysis of variance with one between-subjects factor, feedback condition (DF, MTF, or STF), and three within-subjects factors, type of response (retention of initial lesson response and of the correct response), kind of question (verbatim and inferential), and lesson item difficulty block (difficult, mid-values, and easy). The interaction of feedback and type of response was significant, $F(2, 49) = 7.15$, $MSE = 0.023$, $p < .01$. Follow-up Scheffe' test showed that the DF treatment group mean for ILR ($M = 0.84$) was significantly larger than the STF group mean for ILR ($M = 0.73$), no other mean comparisons were significant.

Table 1
Lesson time data (in seconds), and lesson and retention test means and standard deviations (in parentheses) for each treatment group for each item kind and difficulty level.

			Lesson		Retention Test			
Treatment	Lesson time	Item difficulty	V	I	ILR-V	ILR-I	CR-V	CR-I
STF (n=18)	1577	Difficult	0.46	0.44	0.66	0.66	0.67	0.83
	(280.6)		(0.20)	(0.10)	(0.18)	(0.26)	(0.22)	(0.18)
		Mid-range	0.85	0.57	0.76	0.67	0.79	0.67
			(0.07)	(0.13)	(0.18)	(0.19)	(0.18)	(0.21)
		Easy	0.92	0.82	0.87	0.78	0.91	0.84
			(0.08)	(0.11)	(0.12)	(0.18)	(0.09)	(0.12)
MTF (n=17)	1554	Difficult	0.51	0.55	0.71	0.67	0.71	0.72
	(332.5)		(0.20)	(0.16)	(0.24)	(0.17)	(0.20)	(0.21)
		Mid-range	0.77	0.65	0.79	0.72	0.81	0.74
			(0.07)	(0.04)	(0.18)	(0.16)	(0.17)	(0.17)
		Easy	0.91	0.83	0.86	0.81	0.91	0.81
			(0.09)	(0.09)	(0.12)	(0.18)	(0.12)	(0.18)
DF (n=17)	1899	Difficult	0.48	0.55	0.80	0.81	0.68	0.68
	(409.9)		(0.18)	(0.14)	(0.18)	(0.22)	(0.25)	(0.27)
		Mid-range	0.85	0.65	0.84	0.78	0.85	0.78
			(0.06)	(0.07)	(0.15)	(0.18)	(0.14)	(0.21)
		Easy	0.94	0.78	0.93	0.87	0.89	0.82
			(0.05)	(0.08)	(0.09)	(0.16)	(0.10)	(0.17)

Note. Lesson time is in seconds; standard deviations in parenthesis; V = Verbatim questions, I = Inferential questions; ILR = remembers initial lesson response; CR = recognize correct response; STF = Single-try feedback, MTF = Multiple-try feedback, DF = Delayed feedback. Each item difficulty range is the average of 6 items.

A significant effect was obtained for kind of question, $F(1, 49) = 8.29$, MSE = 0.035, $p < .01$, indicating that the verbatim retention test mean ($M = 0.80$) was greater than the inferential retention test mean ($M = 0.76$), which simply reflects the lesson values for verbatim ($M = 0.74$) and inferential ($M = 0.65$) questions. Next, a significant effect was obtained for question difficulty, $F(2, 98) = 32.20$, MSE = 0.035, $p < .01$. The retention test means for each item difficulty level are: easy items ($M = 0.86$), mid-range difficulty items ($M = 0.77$), and difficult items ($M = 0.71$). As with kind of question above, these retention test values simply reflect lesson values which are: easy items ($M = 0.87$), mid-range difficulty items ($M = 0.72$), and difficult items ($M = 0.50$). Though these findings are significant, they have little practical meaning.

The three-way interaction of feedback, type of response, and question difficulty was significant, $F(4, 98) = 3.52$, MSE = 0.015, $p < .01$. To further examine this complex three-way interaction, two separate follow-up ANOVAs of retention test data are reported below, one of initial lesson response data and one of correct response data. But first this three-way interaction is graphically compared to the delta rule predicted values (see Figure 2) to set the stage for the follow-up analyses.

Since the observed retention data shown in Figure 2 consists of multiple-choice questions, these data were corrected for guessing in order to be consistent with the predicted values. The correction for guessing formula from Nitko (1996) is corrected score = R - W/(n-1) where R is raw score, W is number wrong, and n is the number of multiple-choice alternatives. The lines showing the predicted and observed retention for initial lesson responses (left panel of Figure 2) are highly similar in both magnitude and form, suggesting that the connectionist model presented by Clariana (1999) may adequately account for 24-hour retention of initial learner responses. The lines showing the predicted and observed retention of correct responses (see right panel of Figure 2) are generally similar in shape but are not similar in magnitude. Specifically, the predicted correct response values over-estimate the observed values.

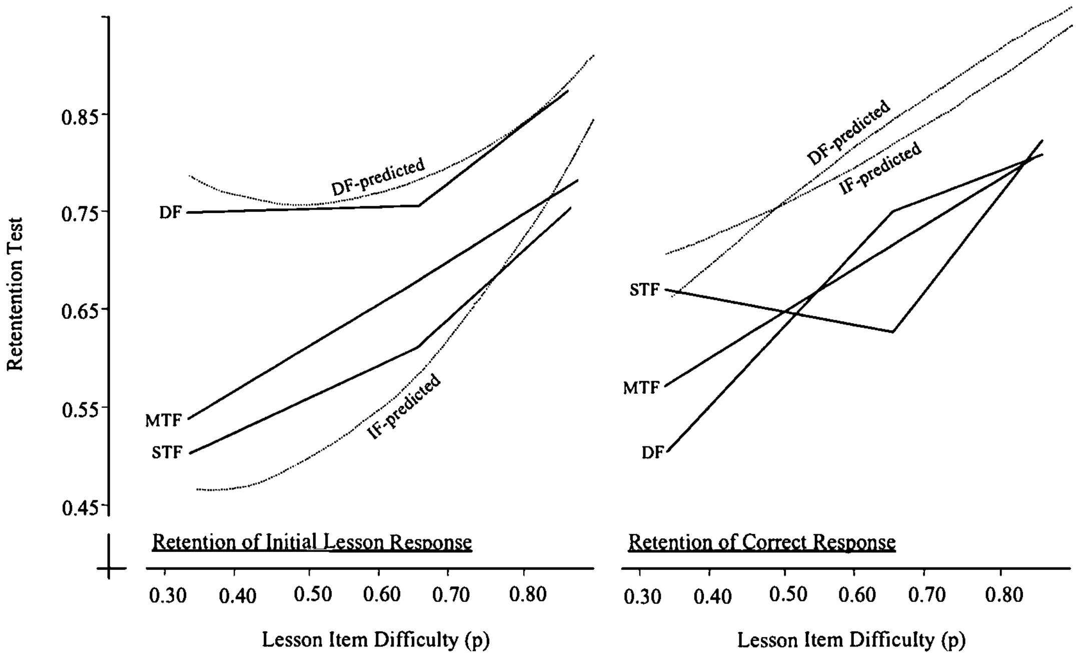

Figure 2. Lesson Response and Correct Response predicted retention test values (dashed lines) for immediate feedback (IF) and delayed feedback (DF) compared to observed data corrected for guessing (solid lines) for delayed feedback (DF), multiple-try feedback (MTF), and single-try immediate feedback (STF)

Follow-up Analysis of Retention Test ILR Data

Retention test ILR data were analyzed by a mixed 3 x (2 x 3) analysis of variance with one between-subjects factor, feedback condition (DF, MTF, or STF), and two within-subjects factors, kind of question (verbatim and inferential) and lesson item difficulty (most difficult, mid-range, and easy). A significant effect was obtained for feedback, $\underline{F}(2, 49) = 4.13$, $\underline{MSE} = 0.081$, $\underline{p} < .05$, as already reported above that retention of ILRs was greater for DF compared to STF (see Figure 2), in addition MTF was more like STF than like DF.

A significant effect was also observed for kind of question $\underline{F}(2, 49) = 8.24$, $\underline{MSE} = 0.024$, $\underline{p} < .01$ and for item difficulty blocks $\underline{F}(2, 98) = 20.24$, $\underline{MSE} = 0.025$, $\underline{p} < .01$. Retention test memory of ILRs for verbatim questions ($\underline{M} = 0.80$) was greater than memory of inferential questions ($\underline{M} = 0.75$). Retention test memory of ILRs for difficult items ($\underline{M} = 0.72$) and for mid-difficulty items ($\underline{M} = 0.76$) was less than memory of easy items ($\underline{M} = 0.85$). As above, though these two findings are significant, they have little practical meaning.

Follow-up Analysis of Retention Test Correct Response Data

Retention test correct response data were analyzed by the same mixed 3 x (2 x 3) analysis of variance. Three findings reached significance. A significant effect was obtained for item difficulty blocks, $\underline{F}(2, 98) = 24.74$, $\underline{MSE} = 0.025$, $\underline{p} < .01$. Scheffe' tests show that retention test memory of correct responses for difficult items ($\underline{M} = 0.71$) and for mid-range items ($\underline{M} = 0.77$) were both less than memory of easy items ($\underline{M} = 0.87$), a finding of little practical interest.

More importantly, the interaction of feedback and item difficulty was significant, $\underline{F}(4, 98) = 2.54$, $\underline{MSE} = 0.025$, $\underline{p} < .05$ (Greenhouse-Geisser $\underline{p} = 0.05$; Huynh-Feldt $\underline{p} = 0.04$). Although this disordinal interaction was directionally consistent with the delta rule predictions, with STF best for difficult items and DF best for easy items (see right panel of Figure 2), follow-up Scheffe' test obtained no significant differences for type of feedback within each question level. Thus the hypothesized differences between DF and STF at different item difficulty levels were too small to be considered reliable.

The interaction between kind of question and lesson item difficulty was significant, $\underline{F}(2, 98) = 7.62$, $\underline{MSE} = 0.023$, $\underline{p} < .01$. Though inferential lesson questions appear to be slightly more effective than verbatim questions for difficult lesson items, follow-up Scheffe' test obtained no significant differences for type of feedback within each

question level. Thus a possible instructional advantage of inferential questions over verbatim questions (per Merrill, 1987) is too small to be considered reliable.

Discussion

The first hypothesis was confirmed that retention of initial lesson responses is greater for delayed feedback compared to immediate feedback across all item difficulties, but especially with difficult lesson items. The association weights of ILR errors increased (see dashed line in Figure 2). Further, the observed retention of initial lesson responses for STF and DF were very similar to their corresponding delta rule predicted values (see left panel of Figure 2). This finding provides empirical support for the potential of a connectionist model to predict instructional feedback effects.

The practical value of hypothesis one for instructional design is that in some learning situations, it is critical to remember initial lesson responses, especially if answers are not absolutely "right" or "wrong" but serve as learning transitions to broader understanding. For example, in discovery learning situations, learners are required to remember and use previous responses. In such cases, delayed feedback or even no feedback would allow learners to maintain initial lesson responses at a greater rate than with immediate feedback. On the other hand, immediate feedback involves a trade-off between increasing correct response associations at the expense of forgetting other responses, and these other responses are likely more meaningful to the learner even though "incorrect". In the many situations where it is critical to strengthen the correct response and diminish the incorrect response, then immediate feedback would be better.

The second hypothesis that feedback has its greatest effect with difficult lesson items was confirmed. Lesson to retention test change at each lesson item difficulty block expressed in effect sizes (ES), calculated as the difference between lesson and retention score divided by the standard deviation of the lesson score, are: for easy lesson items, ES = -.06, for mid-range lesson items, ES = .35, and for difficult lesson items, ES = 1.17. Previous studies have provided the groundwork for this finding by showing that feedback has its greatest effect with difficult items (Sturges, 1978). For example, Bangert-Drowns, Kulik, Kulik, and Morgan (1991) state, "If feedback's primary importance is the correction of errors, then one would expect to see larger effects for instruction with higher error rates. This is exactly what happens" (p.230). Thus, future feedback investigations must consider and control lesson item difficulty, or else results may be confounded by lesson difficulty.

The third hypothesis, that feedback timing interacts with lesson item difficulty, was not supported. However the mean differences were in the right direction with STF best with difficult items and DF best with easier items (see the right panel of Figure 2). This result could be anticipated in that lesson items were not difficult enough to produce the interaction, the average lesson item difficulty for the most difficult question block in this investigation was M = 0.50. Note that the delta rule predicted difference between immediate and delayed feedback would be most pronounced for lesson item difficulties less than about 0.40 (see Figure 2), and are actually predicted to be identical for lesson item difficulties near 0.50. Thus, to adequately test this hypothesis, an unusually difficult lesson would be required. Pragmatically, for computer-based lessons that use multiple-choice questions of reasonable difficulty, immediate and delayed feedback groups should obtain similar posttest scores, with perhaps a slight advantage for delayed feedback.

Though the delta rule predicted ILR values well, this approach overestimated posttest correct response values. Using trend analysis, the values $\alpha\ a_{in} = 0.5$ and $t_o = 0.85$ will adjust the delta rule predictions for posttest correct responses to more closely match the observed data. Future investigations should consider whether these variables of the delta rule are more constant for classes of learner response, or are more variable, perhaps related to individual learner variables.

What are the effects of feedback immediacy and of multiple exposures? MTF was much more like STF in retention test memory of ILRs indicating that feedback immediacy acts to reduce memory of ILR errors, a retroactive interference effect. But MTF rather than clearly mirroring STF (immediacy) or DF (multiple item exposure) generally fell midway between STF and MTF, indicating that both feedback timing and number of exposures combine or interact to impact retention test memory, especially for memory of correct responses. This combination or interaction of immediacy and multiple-exposures is of theoretical interest, and so should be addressed by additional experimentation.

The findings of this study involve only retention test recognition learning outcomes and should not be generalized to other types of learning outcomes, such as recall. Additional research should consider the application of a connectionist model for predicting the effects of feedback on higher-level learning outcomes.

As a footnote, Kulhavy and Stock (1989) have described an information processing explanation of feedback effects based on servocontrol theory (which describes the interaction between system output, sensors, feedback from the sensors, and mechanical devices that impact output). Their model views learner's response

confidence as a metacognitivc component that controls or at least strongly influences how feedback information is processed by the learner. So far (since Sturges, 1978), response confidence studies have shown mixed results (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Mory, 1992; 1994), so whether response confidence serves a metacognitive function in feedback processing is unknown. Requiring a learner to consciously consider the confidence of every lesson response would obviously alter the expected and normal pattern of a lesson, for example increasing the amount of time the learner takes with each item. Further, asking the learner for response confidence at each lesson response may be distracting, and could disrupt the learning process. Also, it has been suggested by Mory (1994) that learners' self-report of response confidence is inaccurate in some cases (see also Metcalfe, 1986). For these reasons, response confidence was not used in this present investigation. However, response confidence could serve as a logical alternative measure of initial lesson output activation level, a_{out}, in the delta rule calculations. Thus, future investigation of the possible metacognitive effects of response confidence may obtain added insight by applying a connectionist model.

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The Effect of Field Dependence and Color-Coding on Female Student Achievement of Different Educational Objectives

Francis M. Dwyer
Penn State University

David M.(Mike) Moore
Virginia Tech

Abstract

The purpose of this study was to examine the effects that level of field dependence and differentially coded instructional materials (black and white and colored) had on female student achievement of different educational objectives. One hundred twenty six college level students participated in the study. On the Total criterion measure significant achievement differences occurred in favor of Field Independent students. A non significant interaction between color-coding and field dependence was found on the Total Test scores. Significant differences in achievement were also found in favor of females who received the color-coded version of the Total Test. These results confirm previous results relating to the importance of field dependence in learning situations and stimulates the necessity for further more sophisticated research to systematically analyze the unique contributions that color-coded instructional strategies might have in facilitating the achievement of female students.

Introduction

A great deal of interest has focused on the concept of learning style as it relates to the way in which individuals process information (Bjorklund, 1989). The learning style concept grew out of the research on how people perceive, interact with and organize information received from the world around them. Results from similar research suggest that individuals differ in how they approach a learning task (Moore, 1985; Moore & Bedient, 1986; Reardon & Moore, 1988) but that these variations do not reflect levels of intelligence (Woolfolk, 1993). Instead they have to do with the "...preferred ways that individuals have for processing and organizing information and for responding to environmental stimuli" (Shuell, 1981, p. 46). Probably the most extensively researched cognitive style, which has the widest application to educational problems, is known as field dependence/independence (Witkin, et al., 1962). The field dependence/independence continuum, as it applies to learners, describes the degree to which learners will interact with a visual presentation, that is, whether the learner will merely interact with the visual as presented or will he/she analyze, reorganize and synthesize the instructional field to make the content more meaningful and memorable (Jonassen & Grabowski, 1993). Field dependent individuals, when presented a visualized presentation tend to modify the structure but accept and interact with it as it is presented. They tend to fuse all segments within the visual field and do not view or interact with the visual components discretely. Field independents tend to act upon a visual stimulus, analyzing it when it is organized and providing their own structure when it lacks organization. The findings of most studies in the literature examining achievement indicate a superiority of FID students over FD student in terms of performance (Canelos, Taylor, & Gates, 1980; Witkin, et al., 1977).

Although many studies have examined the effects of visual attributes on learning (Dwyer, 1978, 1987) few have studied the effects of varied visual attributes on specific cognitive learning styles. Research has shown that color-coding helps learners organize or categorize information into useful patterns, which enables them to interpret and adjust more readily to their environment. It was hypothesized that color-coded visuals would be more effective than black and white-coded visuals in enhancing the solvent visual cues, thereby making them more identifiable and instructional to field dependent learners. The color-coding would attempt to compensate for the restructuring skills absent in the field dependent learners and subsequently lead to deeper information processing and increased achievement. This hypothesis seemed plausible since field dependent learners tend to be global in perception and would be most inclined to take advantage of the increased structure provided by the color-coding. In a study on gender preference in imagery, Rogers (1995b) found that "girls like colors, boys like action." Likewise, Freedman (1989) reported when using computer graphics fifth- grade girls were more concerned than boys with using color and color combinations. Previous research has verified the superiority (Dwyer, 1978, 1987) of color-coded visuals

over black and white illustrations in facilitating achievement of specific types of learning objectives. However, although it has been found that males are generally more field independent than females (Witkin, et al., 1971) it was not known whether color-coding (B&W and Color) and field dependence interact or whether color-coding might positively effect the field dependency of females by enabling them to more effectively and efficiently organize and structure instructional content.

Statement of the Problem

Specifically, the purpose of this study was to examine the effect that color-coding (B&W and Color) has on the achievement different educational objectives of female students categorized as field dependent or field dependent.

Method

One hundred twenty six female students enrolled in basic education courses at The Pennsylvania State University and Virginia Tech University participated in this study. Students were classified as field dependent, field neutral, or field independent as a result of their performance on the Group Embedded Figures Test (GEFT), (Witkin, Oltman, Raskin, & Karp, 1971) and were divided into the different levels based on their mean achievement level on the GEFT.

Each student in each treatment received the Group Embedded Figures Test (GEFT) (Witkin, et al. 1971). The GEFT is a group-administered, 25-item test administered in three timed sections (2, 2, and 5 minutes each). Students must trace one of eight simple figures embedded in figures of greater complexity. Reported reliability is .82. Students participating in these studies were classified as field independent (FI), field neutral (FN) in field dependent (FD) based on their performance on the GEFT. The grand mean for this study was 13.22 with a standard deviation of 4.17. Students achieving one-half standard deviation above the grand mean were considered to be FI while students achieving one-half standard below the mean were considered to be FD. Field neutral students were those achieving one-half standard deviation on either side of the mean. The range of scores achieved on the GEFT was 17.

The subject content for the studies consisted of a 2,000 word instructional booklet on the anatomy and functions of the human heart. Each booklet contained nineteen illustrations, which were designed to illustrate the content. The illustrations in the black and white version contained black and white coded line drawings, which highlighted the information and process being presented. Students receiving the color-coded treatment received the same visuals as did students receiving the black and white treatment; however, several different colors were used to highlight the information being discussed. After receiving their respective coded treatments each student then received a battery of four individual tests (drawing, identification, terminology, and comprehension) and were then were combined into the 80-item Total criterion score. These tests were designed to measure achievement of different types of educational objectives. The major independent variables in the study were the effect that B&W and Color-Coding of information had on the information processing strategies of male and female students identified as processing different levels of field dependence (FI, FN, FD).

Criterion Measures

The following description of the Criterion Tests, adapted from Dwyer (1978, pp. 45-47) illustrates the types of instructional objectives assessed in this study, summarized into the Total Criterion Score.

Drawing Test.

The objective of the drawing test was to evaluate student ability to construct and/or reproduce items in their appropriate context. The drawing test provided the students with a numbered list of terms corresponding to the parts of the heart discussed in the instructional presentation. The students were required to draw a representative diagram of the heart and place the numbers of the listed parts in their respective positions. For this test, the emphasis was on the correct positioning of the verbal symbols with respect to one another and in respect to their concrete referents.

Identification Test.

The objective of the identification test was to evaluate student ability to identify parts or positions of an object. This multiple-choice test required students to identify the numbered parts on a detailed drawing of a heart. Each part of the heart, which had been discussed in the presentation, was numbered on a drawing. The objective of this test was to measure the ability of the student to use visual cues to discriminate one structure of the heart from another and to associate specific parts of the heart with their proper names.

Terminology Test

This test consisted of items designed to measure knowledge of specific facts, terms, and definitions. The objectives measured by this type of test are appropriate to all content areas that have an understanding of the basic elements as a prerequisite to the learning of concepts, rules, and principles.

Comprehension Test.

Given the location of certain parts of the heart at a particular moment of its functioning, the student was asked to determine the position of other specified parts or positions of other specified parts of the heart at the same time. This test required that the students have a thorough understanding of the heart, its parts, its internal functioning, and the simultaneous processes occurring during the systolic and diastolic phases. The comprehension test was designed to measure a type of understanding in which the individual can use the information being received to explain some other phenomenon.

Total Criterion Score

The items contained in the above noted individual Criterion Tests were combined into a composite test score (Total Criterion Test). The purpose was to measure total achievement of the objectives presented in the instructional unit. This was the unit of data used in this study for analysis.

Analysis

A 3x2 analysis of variance was used to analyze student achievement in the Total Criterion Test. The range of scores possible on this test was 0-80. Main effects considered were cognitive style (field dependent (FD), neutral (N), and field independent (FI)), color-coding (color and black & white) and gender. Interactions among cognitive style, color-coding and gender were also of interest. The alpha level was set at .05 for the analysis. The Kuder-Richardson Formula 20 Reliability coefficient of .92 was computed for the Total Criterion Test from a random sampling of prior studies (Dwyer, 1978, p 47).

Results and Discussion

The results achieved on the Total Test supports the expected contention that field independent learners (M= 60.51_) were superior to field dependent learners (M= 45.20) in the cognitive processes they in processing information related to different types of learning objectives use ($F(2,) = 12.14$, $p. < .05$). See Table 1 for means and standard deviations.

There was a significant main effect on color-coding ($F(1,122)=8.92$, $p. < .05$), the analysis of variance conducted on performance data achieved by female students on the Total Criterion Test. The analysis indicated that females who received the color-coded treatments (M= 57.95) achieved significantly higher scores on the Total than did female students who received the black and white coded treatments (M= 49.61). The analysis further indicated that no significant interaction existed ($F(1,122) = 1.77$, $p. >. 05$) between field dependence and color-coding. See Table 1 for means and standard deviations.

Table 1. Means and Standard deviations. Field Dependence

Effect	Count	Mean	Std. Dev.
FD	45	60.51	11.28
FN	49	53.55	14.52
FD	34	45.21	15.92

Table 2. Means and standard deviations. Color and Black and White

Effect	Count	Mean	Std. Dev.
Color	64	57.95	14.09
B&W	64	49.61	14.85

Discussion

The results of this experimental study support the contention that field independent and field dependent learners differ in the cognitive processes they use as in the effectiveness of these cognitive processes as measured on tests measuring different educational objectives. This study found where female FI and FD students reviewed either black and white coded or color -coded treatments, the field independent students scored significantly higher than did field dependent students on the Total Criterion Test. These results support prior research (Moore, 1986) which found that field independent learners tend to score higher on criterion measures which require the acquisition of information from visualized instruction and are used to assessing visually complemented instruction. This finding is also consistent with the previous reviews of the literature that have concluded that field independent learners exhibit an active, hypothesis testing strategy toward learning, whereas field dependent learners tend to employ a more tentative or spectator approval to learning (Witkin et al, 1971). The results also indicated that the use of color-coding of visualization did not provide sufficient structuring of the critical information to alter the information processing level of field dependent learners.

It was expected that the color-coded treatments would make the relevant cues more explicit, thereby improving their performance. The results support this hypothesis. Students who viewed the color-coded materials scored significantly higher than did students viewing the black and white materials, thus supporting the argument that color-coded materials can be of instructional support at least to female students.

These findings indicating that color-coded materials to be more effective for females than the black and white coded materials are among the first findings which lend support to the possibility of differential information processing within the gender domain. It leads to the hypothesis that the color-coded materials may have instigated an active hypothesis testing strategy toward learning, where the students utilized the inherent color-coding strategy to organize and structure the information being presented.

Additionally, the results may have been reinforced if the students were made aware of the intent of the coding structure and/or were given a orientation session as to how they might employ the coding strategies to improve their information acquisition. Under these circumstances the color-coded treatments might have been even more effective in communicating the explicit learning criteria to the learners.

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Journeys of Learning: Policies to Promote Change With Technology in Educational Organizations

Dan Eastmond
Western Governors University

Ms. Gloria Steele
Technology & Innovations in Education (TIE)

Abstract

Learning organizations are discussed within business and industrial frameworks, yet educational enterprises have sought similar revitalization. Today's K-12 and university systems grapple with change, particularly that of telecommunications technology. This session reports on several Midwest US initiatives to foster learning organizations. These projects demand greater inter-institutional collaboration as leaders purposefully create learning networks.

Introduction

Authors like Peter Senge, Chris Argyris, Victoria Marsick, and Karen Watkins have been conducting research about learning organizations for the past several decades. While their published principles make sense for leaders in business and industrial settings -- the organizations within which they conducted their studies -- these same policies and practices must be translated appropriately into educational settings. This session presents the journey of several educational initiatives that have embraced organizational change, intentionally working to develop individual educator, school, district, consortium, and statewide capacity with technology within school and university settings. The presenters, who work in different educational institutions and levels but who collaborate at the State level on one of these projects, will explain the implementation of concepts about learning organizations into a K-12 and teacher education environment, especially involving instructional technology.

Dimensions of a Learning Organization

A learning organization has been defined as one that is "continually expanding its capacity to create its future" (Senge, 1990, p. 14). Such enterprises require continuous learning at all organizational levels, plus procedures to share new knowledge so that the organization improves (Marsick & Watkins, 1999). Within organizations, learning takes place at the individual, team, and institutional levels with connections made outside to professional associations, communities, and the global environment. Learning also takes place through various methods: formal education, training and staff development, informal learning, and incidental learning (Marsick & Watkins, 1990). Features within the organizational environment, such as incentives, communications, and information technology effect the capability of an organization to learn too.

Leadership Policies for Learning Organizations

Policy development toward creating and sustaining learning organizations by visionary leaders provides the greatest impact. These leaders not only share their own conceptions of organizational possibilities, they encourage others to contribute to that vision, and they follow through with implementation of policy and procedures. Although leaders may be found at the top, a shared vision involves leaders and advocates of systemic improvement at all levels of the organization. Such leaders attend to the changes happening outside and within the organization; they seek to maximize the flow and sharing of information by creating knowledge management systems; and they promote learning throughout the organization by setting priorities, encouraging self-directed learning, and noting the individual and group contributions through incentives and recognition (Marsick & Watkins, 1999).

Leaders must foster a supportive environment of trust and shared responsibilities without fault-finding, where tacit assumptions can be challenged and double-looped learning can take place (Argyris, 1999). Senge, et al (1999) provide practical suggestions for policy at each stage of the progression of a learning organization's development. When initiating a learning organization, leaders make time for innovation, garner support, show the relevance of the initiative, and personally exemplify the changed attitudes and behaviors of the five disciplines. To sustain the transformation once a learning organization has been successfully launched, leaders seek to overcome fear and anxiety, find ways to accurately measure impact of change initiatives, and integrate the innovation within

the organization -- unifying divisions that often emerge. As a learning organization becomes fully established, Senge, et al challenge leaders to diffuse innovative change throughout the organization as governance, strategies, and purposes are re-examined and modified.

The school is not now a learning organization as Michael Fullan and other writers remind us. Rather, characteristics such as irregular waves of change, episodic projects, fragmentation of effort, and grinding overload is the lot of most schools. The vast majority of change efforts are misconceived because they fail to understand and harness the combined forces of moral purpose and skilled change agentry. The challenge for all educators is to work toward greater understanding of the new work of principals and teachers as they transform their schools from bureaucratic organizations to thriving communities of learners (Fullan, 1998). Recent education publications and initiatives tell the story of increased momentum among education entities to embrace concepts of learning organizations.

Impact of Technology on Educational Enterprises

Perhaps no innovation of the past century has pervaded our society like the telecommunications technology revolution. Within the past five years the World Wide Web has been commercialized with a global business economy emerging. Similar infusion of telecommunications is radically changing the face of education. For example, one third of higher education institutions in the United States offered distance education courses in 1998; roughly 60 percent of these were delivered via the Internet (U.S. Department of Education, 1999). Public schools throughout the country are being equipped with computer labs, networked classroom computers, and interactive television technologies. Throughout the country various projects and centers are funded to integrate these technologies appropriately into the curriculum. The South Dakota stories and projects shared in the work of this study support the momentum of school change through technology.

The Learning Organizations for Technology Integration (LOFTI) Project

One exemplary project is the Learning Organizations for Technology Integration (LOFTI) Project, a five-year major grant to the State of South Dakota from the U.S. Department of Education for staff development with technology. Begun in 1998, the LOFTI Project aims to provide educators with the knowledge, skills, and abilities essential for teaching and learning in a changing technological world. Technology requires a great deal of collaboration among organizational players, and it is the catalyst for systemic change within smaller projects undertaken by the various educational organizational players. Thus the LOFTI Project networks educators at all levels -- K-12, distance consortia, university, and teacher education -- to share resources and learning about technology.

The LOFTI Project has organized summer academies, known as "Technology for Teaching and Learning " (TTLs) to develop and improve individual educator knowledge, skills, and abilities within specialized roles. Hundreds of teachers, administrators, and technology coordinators are participating in one to three week-long, intensive TTLs for advanced technology skills, networking, technology for administrators, or distance learning technology. The Project is unique because it seeks to intentionally incorporate the five disciplines of learning organizations (Senge, 1990) into its goals of statewide technology integration within education.

One subgroup of the project consists of four showcase schools who have been selected to integrate technology completely into the educational process as a model to others. University players, another subgroup, direct their efforts primarily toward faculty improvement and curriculum development in teacher education using technology. Similarly, the LOFTI Project funds five K-12 consortia that had been set up within the State for distance education to expand their services and improve participating teachers in developing technology skills. The South Dakota Board of Regents and the State Department of Education and Cultural Affairs have teamed up to provide a 15 hour telemediated inservice curriculum for technology using the State's newly formed Electronic University Consortium (see below). The Project is led by the Technology & Innovations in Education (TIE) Office in Rapid City. TIE coordinates several leadership groups for the project, such as: (1) the Design Team which handles the day to day operations of LOFTI; (2) the Steering Committee, made of up representatives of each organizational player, it defines policies and procedures; (3) the Evaluation Team, led by an external evaluator from Maine, this group measures the project's success in meeting its goals and objectives; and (4) the Awareness, Advocacy, and Advisement group is made up of strategic State government, business, and educational partners who provide input in LOFTI Project direction and promote it to other groups.

Discover South Dakota

Discover South Dakota is a multi-dimensional telecollaborative curriculum and professional development initiative. The three major strands of work within the project focus on the design and implementation of (1)student telecollaborative curriculum, (2) a professional development model for Discover South Dakota teachers, and (3) a professional development model for school principals.

Students participating in Discover South Dakota are organized in both classroom-based learning communities and on-line learning communities where they engage in tasks constructed around identified academic content standards, technology standards, and information literacy standards. The curriculum is framed in the study of South Dakota with an integrated, project-based design for learning. Students conduct research, communicate and collaborate with experts and students across the state, and publish to the Discover South Dakota web site. Students make use of e-mail, threaded discussion, and chat features of the telecommunications environment while conducting their work. Partnerships with other education related entities throughout South Dakota, including university pre-service students and teachers, South Dakota Cultural Heritage Center programs, and a variety of experts, are critical to Discover South Dakota curriculum work.

During the 1999-2000 year, fourth, fifth, and sixth grade students in 210 classrooms across the state participated in the Discover South Dakota curriculum experience.

A project-embedded approach has emerged as a professional development model for teachers implementing Discover South Dakota. This model consists of a web of professional development connections available through multiple delivery systems. It includes combinations of face-to- face and on-line experiences that take advantage of both synchronous and asynchronous features of telecommunications. These are supported with print materials, site visits, and technical assistance. Through evaluation of the design and implementation of components of this professional development model, the project seeks to further our understanding of powerful combinations for maximizing the success of teachers implementing telecollaborative teaching and learning in classrooms. In particular, data to study inhibitors and facilitators to this model are being collected.

The Discover South Dakota leadership strand is built on the premise that school leaders are key to successful implementation of innovations in schools. The work for school leaders is organized around a problem-based learning framework focused on project-embedded, just in time delivery of professional development. The overarching problem positions Discover South Dakota as a technological innovation being implemented in their respective schools. In order to examine their current practices, participants engage in a series of topics and activities designed to correlate with the activities of teachers and students during the ten week implementation of Discover South Dakota. This component was conducted as a pilot during the 1999-2000 year and will be scaled up during 2000-2001. Data are collected to study connections between successful implementation of Discover South Dakota by teachers when school leaders are participating in this companion professional development experience.

Connecting the Schools

The Connecting the Schools (CTS) project is the follow-up endeavor to Governor Bill Janklow's Wiring the Schools project (wts.state.sd.us). Wiring the Schools established a solid local area network (LAN) and electrical infrastructure in the K-12 school buildings across South Dakota. CTS is building on that foundation for the creation of a statewide video and data intranet to improve the educational opportunities for K-12 students in South Dakota. CTS has 3 distinct phases:

1. Equipment seeding
2. Network infrastructure
3. Distance learning

The equipment seeding is a one-time distribution of hardware and software to insure that schools have a quality LAN infrastructure to build upon. Many schools will go from having little or no technology to a level that will allow them to quickly leap into the 21st century! The equipment phase began in May 1999 and will conclude in September 1999. The network infrastructure named Digital Dakota Network (DDN) provides a frame relay or ATM T1 to approximately 400 public school buildings in the state. The general rule is that elementary schools (K-6) receive frame relay and that grades 7 - 12 receive ATM. The frame relay circuits deliver data communications (e.g., Internet, World Wide Web, e-mail) and the ATM circuits deliver data and video. Telecommunications companies in the State are installing interactive video room systems in the distance learning classrooms.

E-mail and web hosting services are also being provided. Dakota State University is providing these services under contract to the CTS project. Thin client technology will serve Exchange collaboration tools to

teachers and administrators across the state. Web hosting will allow the publishing of district, school, teacher, classroom and student information.

The distance learning phase of the project will remove limitations for students and provide them learning opportunities regardless of geographic location. The video conferencing service will provide two-way audio and video communications to an estimated 200 schools across the state. The distance learning phase is going to take significant cooperation and planning amongst South Dakota schools. The scheduling, curriculum sharing, and communicating of available resources is absolutely vital to the success of this phase. The distance learning services will be available in September of 2000.

Electronic University Consortium

Still in its planning stages, the Electronic University Consortium (EUC) seeks to coordinate the efforts of South Dakota's six regential institutions toward off-campus and distance provision of courses and programs. It will establish a single Web point of contact for students to access a variety of services -- from admissions, registration, billing, and transcript services through the delivery of courses and library services. The EUC will coordinate the curriculum development effort of the various institutional members while avoiding unnecessary duplication. In new curricular development, its focus will be on meeting the information technology needs of business, industry, medicine, government, and K-12 enterprises. Its outreach will be to those who cannot conveniently attend classes on a regular college campus. A fifteen credit hour telemediated teacher education curriculum developed through the LOFTI Project provides an impetus for other EUC curricular development.

Observations and Reflections

This presentation information summary concludes with some of our reflections about the successes, growth, and challenges provided by the technology initiatives and efforts towards organizational learning reported in this paper. Although we have been involved in variety of organizations, this is the first time we have seen the major educational players in the State come together ostensibly for the purpose of collaboration, teamwork, and shaping its future capacity building through creating learning organizations with technology. Several times yearly, Statewide meetings focus on various aspects of building learning organizations, and those in local leadership positions of the LOFTI Project are uniquely placed to facilitate the greater understanding and buy-in to these concepts. Many of the innovations with technology overlap with LOFTI, such as the Discover South Dakota, Connecting the Schools, and the Electronic University Consortium, giving educators first-hand experience with collaboration and initiative development with technology.

The positive aspects of learning organization building are pronounced. These projects are benefited by visionary leaders who make the building of learning organizations a top priority. Besides the practical day-to-day projects undertaken by various project members, these initiatives facilitate greater discussion about technology and the future that it plays in the educational future of the State. Slowly but surely a vision of exciting possibilities is emerging where South Dakota educational enterprises are not only about to better serve their citizens through technology, but they are also able to reach out nationally and globally to become a greater player in the global telecommunciations economies of the future.

There are still numerous challenges that have yet to be faced and overcome. First, Statewide cooperation is often hampered by politics, competition over limited resources, and mistrust that equitable outcomes will result. These assumptions are only just beginning to be recognized and openly confronted at LOFTI and other project meetings. For example, in February 2000 the broad-based, Steering Committee, looked at teamwork within its various members. Without exception, a pre-session survey revealed that individual members felt better about their own contributions toward participation, collaboration, flexibility, sensitivity, risk-taking, commitment, facilitation, and openness that they did of other members. They felt that the Committee was only moderately effective as a high performance team, and that its members did not know or allow others to share their individual talents and skills. The descriptor most chosen to represent their feelings about participating was "challenging," and several of the survey comments were directed toward the building of greater trust for this learning organization to improve (Survey Results of LOFTI Steering Committee, 1999).

Technology has often become the focus and end in and of itself, rather than a means towards building our future. Educators still struggle to translate the concepts and disciples for learning organizations from the business world to that of education. The "bottom lines," "customers," and "productivity measures" are quite different. It is still difficult to create local visions of larger regional or statewide learning organizations when educators are pressed to accomplish their daily tasks as efficiently as possible without tangible rewards visible for collaboration and sharing. It is also difficult to systematically build shared vision, personal mastery, mental models, team learning,

aligned with systems thinking (Senge, 1990) and embracing features made possible through new technology-rich learning environments.

In closing, it is an exhilarating time to be participating in the creation of learning organizations within education involving technology. This paper highlighted several initiatives within the State of South Dakota that are directed toward this end. It brought together theories about leadership policies to create learning organizations that have surfaced in the literature and reported upon the progress and challenges faced by those working with these ideas in educational technology initiatives within the state of South Dakota today.

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Uses of the World-Wide Web by Adolescents in Public Schools

Samuel E. Ebersole
University of Southern Colorado

Abstract

This study was designed to explore how some students in ten public schools view the WWW and how their attitudes and opinions affect their use of this new medium in an educational context. An exploratory principal components analysis of forty use statements resulted in an eight factor solution. Additionally, student responses to a computer-administered survey instrument were collected and analyzed revealing significant differences in the way that students describe their use of the WWW. Gender, grade level, and amount of time spent using the WWW were used to create between-group comparisons of the WWW use categories that made up the computer-administered survey instrument. The final phase of data analysis was a content analysis of sites visited by students. A total of 123,071 URLs were collected from the computers used to administer the computer survey instrument. These were reduced to a total of 500 sites that were reviewed by media specialists. Students were found to be visiting commercial sites at a much higher proportion than those in other domains. Also, the commercial sites received the lowest rating for "suitability for academic research" of all the domain names. And while students reported their purpose for using the WWW as "research and learning" fifty-two percent of the time, the coders found only twenty-seven percent of the sampled sites to be "suitable" for that purpose.

Introduction

This [PC/Internet] technology promises to have a far larger and more serious impact on our society than the introduction of television, possibly as great an influence on history as the industrial revolution or the printing press. Television primarily involves only leisure time; this technology will affect work, school and play—personal, family and business relationships. Surveying the Digital Future: How the PC and Internet Are Changing the World.

The introduction of a new medium into society has frequently been a flash-point for media effects research focusing on children and adolescents (Wartella & Reeves, 1985). In each case children have been recognized as a special audience, one that deserves special consideration (Dorr, 1986; Wartella, 1995). The introduction of television prompted numerous studies (e.g., Schramm, Lyle & Parker, 1961), and provoked much discussion and public debate over its proper place in society. The effects of the media on children's mental development has been a common theme (e.g., Van Evra, 1990; Winn, 1977). From early on, media effects researchers have focused the attention of the nation on the media's dysfunctional effects. From the Payne Fund studies on the effects of motion pictures (e.g., Charters, 1933; Dale, 1935) to Dr. Fredrick Wertham's (1954) exposé of comic books to the Surgeon General's (1972) report on television and violence, social scientiara have examined how the media have served to undermine the positive influences of family and social institutions (McLeod & Reeves, 1980; Wartella & Reeves, 1985).1

Researchers exploring the effects of educational media, however, have argued from a similar set of assumptions to reach dramatically different conclusions. Instead of exploring the possible negative effects of the media, proponents of "powerful effects" have heralded the positive effects promised by the use of educational media in the classroom (e.g., Kozma, 1994; Salomon, 1978). The history of educational technology, specifically the use of mass media in an educational context, is infused with promises of revolutionary proportions (Cuban, 1986). Access to books, instructional motion pictures, radio, and more recently television and interactive multimedia has been envisioned as the panacea for all that ails our educational system. The use of the World Wide Web in the classroom is only the latest in a long history of mass media technologies that have been embraced by the educational establishment. Libraries, along with the liberating technologies of the postal service and telephones, were once envisioned as facilitating the elimination of schools (Illich, 1970).2 Educational films, radio and television programs, and educational computer software have all been employed with similar hope and optimism. The belief that the Web will lead to the promised land is but the most recent manifestation of this technological utopianism.

Statement of the Problem

The Internet, and more specifically the WWW, is being eagerly adopted by school districts, administrators, and teachers almost without exception. However, the use of the WWW in the classroom marks the first deployment of an educational medium in which the end user can access a virtually unlimited breadth of content. Hecht (1997) argued, "having the Internet in the classroom is like equipping each classroom with a television that can be turned on at any time and tuned in to any of 100,000 unrestricted channels, only a tiny fraction of which are dedicated to educational programming (and even those have commercials)." McNealy (1999) voiced a similar concern when he wrote, "Right now, putting students in front of Internet terminals is no better than putting them in front of TV sets. It may even be worse" (p. 17A). And while the resource is huge-Lawrence and Giles (1999) estimated 800 million web pages-some have argued that only a fraction of the millions of Web pages hold any educational value for this K-12 audience (see, for example, Bennett, Wilkinson, & Oliver, 1996; Kirk, 1996; Tillman, 1998).

This raises some interesting questions regarding the use of the WWW in an educational context. Even students who seek out educational content may be thwarted by the very attributes heralded by WWW proponents, e.g., the WWW's breadth and depth of information. Research into selective exposure, defined as "behavior that is deliberately performed to attain and sustain perceptual control of particular stimulus events," (Zillmann & Bryant, 1985, p. 2) has raised questions about new media technologies that provide an abundance of choice and place even greater control over consumption in the hands of the consumer. In a nonlinear medium, when educational content is sometimes packaged as "edu-tainment," what is to prevent students from skipping over the "education?" Preliminary data collected during a pilot study (Ebersole, 1999) indicated that for middle and high school students accessing the WWW from computers in public schools, the most frequently visited sites were those that were also the least educational. And while "research" was the most frequent response to the question "why are you using the WWW at this time?" content analysis of the sites visited suggested that "looking for something interesting" was the more likely explanation for the majority of sites visited.

Significance of the Study

There have been calls for research to determine the effect of computers with Internet access on student achievement (Kozma & Quellmalz, 1996). Linda Roberts, Director of the Office of Educational Technology, spoke at the SchoolTech Exposition and Conference and reminded educators of the need to collect data that will support or reject the spending of billions of dollars for computers and wiring (Mendels, 1998, April 27). A recent US Department of Education report (National Center for Educational Statistics, 1997) concluded by listing four challenges that remain for educators and school districts as they embrace this new educational technology. The challenges are: technical support for hardware and software; teacher training and development; "increasing effective use of the Internet to enhance student learning; and protecting students from inappropriate material on the Internet". Research into the use of the WWW in public schools has important implication for local, state, and national policy and funding initiatives. While a study such as the present one is only a small step in the quest to assess the value of this new medium, it is important in that it permits identification of the motivations of individual users. The study can also help to identify crucial points where intervention may be necessary in order to realize the WWW's full potential as an educational resource. Once we understand what motivates students to utilize this medium, we can better design incentives that encourage educational use and discourage use that distracts students from that goal.

Theory: Uses and Gratifications

According to Rice and Williams (1984), "the new media provide fertile test beds for many of our theories and models" (p. 55). One mass media theory that has repeatedly been cited as holding promise for the analysis of new media is uses and gratifications. In addition to the article by Rice and Williams, articles by Williams, Strover and Grant (1994), Newhagen and Rafaeli (1996), Morris and Ogan (1996), and December (1996) have also included references to the suitability of uses and gratifications for new media research. As an "active audience" theory, uses and gratifications provides a vantage point from which to look at the ways that audiences respond to the breadth and depth of information that is made available by these new media. Newhagen and Rafaeli (1996) have suggested that uses and gratifications theory may be especially useful because of the "mutability" of the Web, or what Newhagen calls its "chameleon-like character" (p. 11). The diversity of content is much greater for the WWW than for traditional electronic media. While television, radio, and to a lesser degree print media are subject to regulatory and societal scrutiny, the WWW is virtually unregulated. Because of this, the WWW literally has something for everybody. The fact that this range of material is available at school, library, workplace, and home would suggest that potential uses for the Internet may far exceed those provided by other media.

Few studies have taken a uses and gratifications approach to studying the Internet and even fewer have narrowed their focus to look at the WWW (e.g., Charney, 1996; Stetter, 1997; Yoo, 1996, and Kaye, 1998). December (1996) identified "communication, interaction, and information" as the three broad categories for why people use the Internet. Charney (1996) concluded from a study of university students that the Internet is used "to keep informed, for entertainment and diversion, to maintain communication, and to look at the sights and sounds of the 'Net" (p. 88), but most frequently for entertainment-diversion (p. 90). A 1995 study of college students' WWW usage resulted in "six motivational categories: entertainment, social interaction, passing the time, escape, information, and Web site preference" (Kaye, 1998, p. 34). According to the 9th WWW User Survey conducted by Georgia Tech (GVU's 9th WWW user survey, 1998), the WWW's youngest users (11-20) use the web mainly for "entertainment" (81%), "education" (70%), "time wasting" (67%), and "personal information" (60%).

Methods

Combining qualitative and quantitative approaches, this study employed open-ended questions, interviews, two types of survey research, and content analysis of WWW sites visited by students. Some of the data was collected with the active participation of the subjects, while other data was collected using passive data collection techniques. Using multiple methodologies allowed for increased richness of data and a clearer picture of the phenomena under investigation.3

Subjects

The population for this study was comprised of middle-school and high-school students at selected public schools in five districts in a western state. The districts were selected in consultation with the state's Department of Education to reflect a cross-section of schools in urban and rural settings that have Internet access. The participants for this study were selected using two different approaches. For the first survey, which was administered on paper, a stratified convenience sample was employed. At one middle school and one high school in each district a class representing each grade (sixth, seventh, eighth, ninth, tenth, eleventh, and twelfth) was selected to take the paper survey. The second survey was administered electronically at the computer. Students attending middle and high schools in these districts have access to the WWW using computers available in the schools' media centers. However, not all students had parental permission to access the WWW. Only students who had been granted parental permission and who had signed and submitted the required forms to their local school administrators were permitted to access the computer-administered survey. Of these, participation in the second phase of the survey was voluntary and by self-selection. The survey was installed as the default home page in the media centers for a period of time sufficient to gather approximately 100 responses from each school.

Survey Data Collection

The two primary survey instruments employed in the current study will be referred to as the "paper survey" and the "computer survey." The paper survey is a 75-item survey instrument that was administered to students in their classrooms at selected public middle schools and high schools. The paper survey contains sections designed to measure the students' : 1) affinity for the WWW, 2) assessment of the value of the WWW for various purposes, 3) skill level for computer and WWW use, 4) use of the WWW, 5) avoidance of the WWW, and 6) demographics. Following this, the computer survey was administered to the students at the time and place of their access to the WWW-specifically the school's media center or library. The computer survey is comprised of just four questions: grade, gender, how much the student uses the WWW, and the student's purpose for using the WWW at this particular time. This survey was intentionally kept very short in order to prevent student frustration and a perception of "time-off-task" that may have jeopardized the support of school administrators.

Passive Data Collection Design for This Study

December (1996) and Newhagen and Rafaeli (1996) recognized the fact that the Internet provides excellent opportunities for data collection. As Rafaeli noted, any social scientist who has looked at an Internet server must be struck by the research possibilities present in the data that is passing through that computer (p. 6). In order to take advantage of this unique feature of the WWW, the design of this study calls for passive data collection to follow the survey research. Both Netscape Navigator and Microsoft's Internet Explorer browsing software generate a cache or "global history" file that resides on the user's hard drive and which retains a list of addresses (Uniform Resource Locators or URLs) of WWW sites last visited. This list of URLs listing WWW pages and graphics visited most recently is extensive and can be thousands of sites long.

At the beginning of the data collection phase the cache files on the computers in the schools' Media Centers were deleted. At the end of the collection period the cache files were copied to a disk and the data prepared for analysis. A total of 123,071 URLs were collected from the more than 80 Macintosh and Windows personal computers on which the survey instrument had been installed. First, the number of occurrences of web sites from the five generic top-level domains (commercial [.com], educational [.edu], governmental [.gov], network [.net], and organizational [.org]), and the United States (.us) domain was recorded. In order to facilitate content analysis of the sites visited, URLs ending with .gif and .jpg were first stripped from the list and then a UNIX grep script was written and applied to the remaining sites to reduce the list to the number of randomly selected sites that could be evaluated and coded given the time and resources available. The subsequent 500 URLs were then collected into a single WWW page and two educators/media specialists, one male and the other female, from a nearby school district were asked to analyze these WWW pages and serve as evaluators. The pages were assigned a "use" category based on the same choices that had been presented to the students on the computer-administered survey and were rated for "suitability as a source for academic research" on a scale of 1-3: 1 = not suitable, 2 = questionable, and 3 = suitable. The evaluators were instructed to look at each WWW page with consideration for the grade level of the students being studied.

Results

Respondents to the paper survey (n = 791) ranged in age from 10-21 years (M = 14.45) and were enrolled in the 6th grade (12%), 7th grade (130, 17%), 8th grade (123, 16%), 9th grade (14%), 10th grade (15%), 11th grade (12%), and the 12th grade (16%). Average self-reported grade point average (GPA) was 3.28, and 51% were male. Ethnicity of respondents is as follows: American Indian (2%), Asian (3%), Black (9%), Hispanic (16%), White (69%), and other (2%). Respondents to the computer-administered survey (n = 1083) were enrolled in the 6th grade (5%), 7th grade (21%), 8th grade (19%), 9th grade (14%), 10th grade (15%), 11th grade (12%), and the 12th grade (16%). Of these, 59% were male.

Attitudes towards the WWW

Questionnaire items 1 through 5 were statements designed with the goal of determining the students' affinity for the WWW. This was operationalized by summing five Likert-scale responses with results ranging from 5-25 (M = 12.57, SD = 4.12, Cronbach's alpha = .83). The statement "Using the WWW is very important to me" received the strongest support (M = 3.05) while the statement "I would feel lost without the WWW" received the least (M = 1.97).

The next set of items was designed to explore the students' beliefs about the WWW-in particular the WWW's value as a source of information, entertainment, and as a means of communication. As a source of information (M = 1.68, 1 = excellent, 4 = poor), students rated the WWW as "excellent" 44% of the time, "good" 46% of the time, "fair" 9% of the time, and "poor" 2% of the time. As a source of entertainment (M = 1.90), students rated the WWW as "excellent" 36% of the time, "good" 42% of the time, "fair" 18% of the time, and "poor" 4% of the time. And as a means of communication (M = 1.78), students rated the WWW as "excellent" 42% of the time, "good" 42% of the time, "fair" 14% of the time, and "poor" 3% of the time. Based on these responses, students rate the WWW highest for information, followed by communication, and then entertainment.

The most common response to a general question asking overall skill at using computers was "good" (47%), followed by "average" (30%), "excellent" (20%), and "below average" (3%). Additional questions asked students how long they have being using the WWW, how many times per week, and how many hours per week they use the WWW. To the question, "For how long have you been using the World-Wide Web?" the most common response was "1-2 years" (32%), followed by "more than 2 years" (29%), "6 mo.-1 year" (23%) and "less than 6 months" (17%). To the question, "Approximately how many times per week do you use the World-Wide Web?" the most common response was "1-2 times" (35%), followed by "less than 1" (28%), "3-5 times" (23%), and "more than 5 times" (15%). And in response to the question "About how many hours per week do you use the World-Wide Web?" respondents answered "1-2 hours" (34%), "less than 1" (33%), "3-5 hours" (20%), "6-10 hours" (9%), and "10+ hours" (5%).

An additional four items assessed the respondent's skill at using the WWW. Students' self-reported skill at using the WWW was operationalized as the sum of responses to four Likert-scales. Skill at using the WWW ranged from 4 to 20 (M = 13.86, SD = 3.25, Cronbach's alpha = .78).

Students were also asked to indicate the locations where they access the WWW. The 625 students who responded to question 20 indicated the following places were used to access the WWW; home (69%), school (61%), friend's house (32%), public library (23%), and, other (11%).

Reasons for using the WWW

Questionnaire items 21 through 60 addressed reasons why students might choose to use the WWW. These items were generated from statements made by middle school and high school students who responded anonymously to an open-ended question asking them to list several things "that the World-Wide Web is good for." Additional use statements were taken from fill-in-the-blank responses to the computer survey questionnaire in the pilot study.

Because of the paucity of research in uses and gratifications of the relatively new WWW, exploratory factor analysis (SPSS Principal Components Analysis with Varimax rotation) was employed to group these use statements into categories. A preliminary principal components analysis was performed on an incomplete data set in order to arrive at a list of "use statements" that became part of the computer-administered survey instrument. Those seven use statements were: "for research and learning," "to communicate with other people," "for access to material otherwise unavailable," "to find something fun or exciting," "for something to do when I'm bored," "for sports and game information," and, "for shopping and consumer information." Once the complete data set was collected via the paper survey instrument, another principal components analysis was conducted. This time the result was eight factors with eigenvalues greater than 1.0 accounting for a total of 58% of the total variance. These factors differed slightly from those derived from the earlier analysis.4 (see Table 1).

Table 1

Items	FAC1	FAC2	FAC3	FAC4	FAC5	FAC6	FAC7	FAC8
Factor 1: Research and Learning								
(eigenvalue = 10.57, variance after rotation = 14%)								
Because it is a good source of news	.488	.237	-.048	.117	.266	.141	-.165	.238
To complete homework assignments	.553	.063	.114	.031	.296	-.336	.392	.047
To get up-to-date facts and information	.445	.195	.026	.080	.214	.224	-.117	.397
To learn how to use computers better	.423	.307	.172	-.095	-.019	.206	.195	.074
To learn new things †	.501	.554	.140	.019	.132	.045	.009	.082
Because it provides a new outlook on learning	.727	.264	.149	.000	.067	.113	-.045	.015
Because it's educational	.749	.237	.054	-.071	-.024	.110	-.047	-.052
To find articles and references	.675	-.115	-.008	.035	.270	.241	-.086	.071
Because it is an excellent source of information	.682	.118	.085	.126	.233	.025	-.090	.056
To find out what's going on in the world	.566	.175	.227	.269	-.058	.256	-.037	.196
So that I can do better in school	.763	.190	.140	.077	-.048	-.014	.077	.007
To conduct research for class	.766	-.061	.009	.026	.214	-.046	.013	-.046
Factor 2: Easy Access to Entertainment								
(eigenvalue = 3.73, variance after rotation = 9%)								
Because it's so easy	.185	.521	.049	.203	.286	-.007	-.161	.256
Because it's fun	.094	.746	.129	.281	.148	.037	.091	.091
To learn new things †	.501	.554	.140	.019	.132	.045	.009	.082
To play games †	.036	.434	.102	.325	.028	.030	.537	.068
Because it's exciting	.238	.712	.180	.177	.063	.084	.130	-.001
For entertainment †	-.002	.508	.212	.467	.149	.076	.190	.077
To find interesting things	.351	.573	.117	.121	.206	.237	-.007	.024
Because computers are cool †	.226	.453	.105	.428	-.075	.331	.094	-.096
Factor 3: Communication and Social Interaction								
(eigenvalue = 2.19, variance after rotation = 9%)								
To chat with other people	-.030	.033	.716	.220	.241	-.103	.161	.122
To find people	.086	.101	.637	.056	.104	.027	.158	.232
So that I can have foreign language friends	.168	.232	.594	-.034	-.129	.221	-.089	.110
To email friends	.096	-.005	.520	.263	.279	.082	-.079	.184
To talk with people from around the world	.145	.156	.788	.061	-.020	.123	.038	.011
To meet new people	.116	.106	.801	.165	-.003	.135	.009	.063

Factor 4: Something to Do When Bored								
(eigenvalue = 1.68, variance after rotation = 7%)								
For entertainment †	-.002	.508	.212	.467	.149	.076	.190	.077
For browsing	.266	.185	.109	.510	.254	.239	-.007	-.022
Because it gives me something to do	.018	.258	.186	.761	.055	.045	.100	.104
When I'm bored	-.003	.152	.155	.796	.085	-.017	.064	.106
Because computers are cool †	.226	.453	.105	.428	-.075	.331	.094	-.096
Factor 5: Access to Material Otherwise Unavailable								
(eigenvalue = 1.53, variance after rotation = 6%)								
To find things not in the library	.240	.060	-.020	-.004	.652	-.041	-.063	-.088
Because it is convenient	.143	.198	.131	.264	.537	.041	-.088	.170
To download software and other free stuff †	-.115	.177	.217	.042	.425	.438	.302	.153
Because I can access things otherwise unavailable to me	.167	.178	.119	.086	.617	.280	.067	.020
Factor 6: Product Info and Tech Support								
(eigenvalue = 1.17, variance after rotation = 5%)								
To download software and other free stuff †	-.115	.177	.217	.042	.425	.438	.302	.153
To get product information	.197	.102	.136	.040	.245	.489	.044	.125
To get information about games †	.011	.292	.067	.272	-.012	.467	.511	-.002
To get technical support	.348	.097	.261	.127	.064	.610	.148	.096
Factor 7: Games and Sexually Explicit Sites								
(eigenvalue = 1.09, variance after rotation = 5%)								
To get sports information and statistics †	.243	-.002	-.018	.072	-.072	.194	.439	.413
To access sexually explicit sites	-.191	-.001	.058	-.001	-.032	.055	.672	.077
To play games †	.036	.434	.102	.325	.028	.030	.537	.068
To get information about games †	.011	.292	.067	.272	-.012	.467	.511	-.002
Factor 8: Consumer Transactions								
(eigenvalue = 1.08, variance after rotation = 4%)								
For shopping and making purchases	.001	.023	.247	.054	-.015	.089	.107	.701
To look up music and concert information	.020	.138	.268	.084	.102	-.010	.092	.674
To get sounds, pictures, or animations for projects *	.259	.360	.077	.091	.366	.097	.180	.199
Cronbach Alpha (for scale)	.887	.844	.823	.813	.601	.653	.617	.577

* Denotes item that did not meet the criteria for factor loading

† Denotes item that loaded highly on two factors

Correlation Analyses

Following the independent-sample t tests, Pearson product-moment correlation coefficients were computed among the eight WWW use scales and three variables measured at the interval level. The three variables that were correlated with the eight factors were grade, affinity for the WWW, and skill level at using the WWW. Not surprisingly, both affinity and skill are positively correlated with every type of use as defined by this study. The few significant correlations between grade and uses suggest that students in the lower grades are more likely to say that they use the WWW for easy access to entertainment, for something to do when bored, for product information and technical support, and for games and sexually explicit sites. Likewise, students in the higher grades are more likely to say that they use the WWW for access to material otherwise unavailable. A significant negative correlation was obtained between grade level and affinity for the WWW ($r = -.15$, $p = .001$). This suggests that as respondents increase in age and grade level, they become less enamored of the WWW. Note, however, that this reduction in affinity for the WWW does not appear to result in less use with increased age. The correlation between grade level and skill level was not significant ($r = -.02$, $p = .717$). The lack of correlation between grade and skill level may be

accounted for by the likelihood that students rated their skill level against that of their peers rather than against an objective scale.

Reasons for avoiding the WWW

In addition to seeking reasons why students choose to use the WWW in a school setting, questions were asked in an attempt to discover possible reasons why students would choose to avoid using the WWW. Ten avoidance statements were presented to students who were asked to respond on the same agree/disagree scale. An analysis of the avoidance statements suggested that face-to-face interaction with peers is the leading reason given for not spending time using the WWW. Other important factors included several statements about negative issues commonly attributed to the WWW, e.g., pornography, illegal activity, and other users who may have suspect motives. And while schools often have fast connections to the Internet, these users appeared to be consistent with the general population of WWW users who perceive the WWW to be too slow, especially when downloading graphically intensive sites. On a positive note, the social stigma that has been associated with computer expertise-i.e., that "computers are for nerds"-does not appear to carry much weight with these respondents.

Results of the Computer-Administered Survey

Unlike the nearly even split by gender in the paper survey, the respondents to the computer-administered survey were slightly more than 59% male. This could indicate that males are heavier users of the WWW at school, or that they were more likely to respond to the survey. While the breakdown of respondents by grade level to the paper and computer surveys was identical for high school students, there was a substantial difference in the number of sixth, seventh, and eighth grade students responding to the two surveys. The reduced percentage of sixth grade students responding to the computer-administered survey was explained in part by the fact that one district did not provide Internet access to sixth grade students. Because there was no way to prohibit multiple responses from students responding to the computer-administered survey, the data reported here should not be interpreted as representing unique students, but rather as sessions at a computer.

In response to the question asking the average amount of time spent using the WWW each week, the most common response was, "less than 1 hour per week" (36%) followed by "1 to 2 hours per week" (23%), "3 to 5 hours per week" (18%), "more than 10 hours per week" (17%), and "6 to 10 hours per week" (6%). Respondents to the computer-administered survey gave the following reasons for using the WWW: "for research and learning" (n = 541, 52%), "to communicate with other people" (n = 74, 7%), "for access to material otherwise unavailable" (n = 55, 5%), "to find something fun or exciting" (n = 85, 8%), "for something to do when I'm bored" (n = 56, 5%), "for sports and game information" (n = 65, 6%), and, "for shopping and consumer information" (n = 10, 1%). In addition, 165 students (16%) chose not to select from the seven options presented. Of these, 94 students elected to write-in a response to this question. The write-in responses offered by students to explain their purpose for using the WWW were grouped into categories as follows: specific research topics (n =20), sexually explicit material (n =20), games and amusements (n =14), general research and learning (n =11), combinations of things (n =10), communication (n =5), and other unclassified (n =14).

Content Analysis of Sites Visited

Because there are normative expectations for media content consumed in school for educational purposes, content analysis of sites visited by students was employed to better understand the nature of the content being consumed. Of the 123,071 URLs collected, 77% (n = 94,426) were from the .com domain, 5% (n = 6,289) were from .net, 5% (n = 5,704) were from .org, 4% (n = 4,842) were from .edu, 1 percent (n = 1,640) were from .gov, 1% (n = 1,403) were from .us, and 7% (n = 8,767) were from another or unidentified domain name. These numbers stand in contrast to the distribution of domain names that makes up the current state of the WWW. According to the latest survey of WWW domain names by host count, conducted by Internet Software Consortium in January of 2000, the actual make-up of the WWW is not as heavily skewed towards the commercial domain sites as the student sample would suggest (see Table 2).

Table 2
Domain Names by Host Count

Domain Name	Number of sites*	% of total (com, net, edu, us, org, gov)	% of 123,071 Web pages visited by students
com (commercial)	29075185	50.4	77
net (network)	18305485	31.7	5
edu (education)	6313781	10.9	4
jp	2680659		
uk	2240216		
us	2062653	3.6	1
mil	1908413		
de	1778831		
ca	2153807		
au	1181376		
org (organization)	1063901	1.8	5
nl	839912		
fr	867981		
gov (government)	842854	1.5	1
Total	57663859	99.9%	93% (7% = other)

*Source: Internet Software Consortium, January 2000

The next step was a more detailed content analysis of randomly selected WWW pages visited by students. Once intercoder reliability was established at an adequate level (alpha = .92), the 500 randomly selected WWW pages were analyzed for educational value and use category. The "suitability" rank most often assigned by the evaluators was "not suitable" (n = 262, 57%), followed by "suitable" (n= 135, 29%), and "questionable" (n = 65, 14%). The use category most often assigned by the evaluators was "for research and learning" (n = 126, 27%), followed by "access to material otherwise unavailable" (n = 102, 22%), "to find something fun and exciting" (n = 76, 17%), followed by "for shopping and consumer information" (n = 61, 13%), "for something to do when I'm bored" (n = 45, 10%), "for sports and game information" (n = 30, 7%), and finally, "to communicate with other people" (n = 22, 5%).

When compared to the use categories self-reported by the students responding to the computer-administered survey there is clearly a disparity between the way that students and media specialists view the content and potential use of these WWW sites. Students' self-reported uses of the WWW was as follows: "for research and learning" (n = 541, 52%), followed by "to find something fun and exciting" (n = 85, 8%), "to communicate with other people" (n = 74, 7%), "for sports and game information" (n = 65, 6%), "for something to do when I'm bored" (n = 56, 5%), "for access to material otherwise unavailable" (n = 55, 5%), and finally, "for shopping and consumer information" (n = 10, 1%).

The disparity between self-reported uses of the WWW and evaluators' assessments of actual sites visited invites several possible explanations. First, as an audience-centered theory of media use, uses and gratifications allows for individual interpretation of content. It should not be surprising that students and media specialists frequently envision different uses for the same Web site. Second, students may be responding to the survey with answers that they believe are socially acceptable. Even with the anonymity provided by the computer survey technique, students may feel some pressure to respond in a manner that is congruent with the stated purpose of the WWW in school as elaborated in the school district's Acceptable Use Policy-namely, academic research. However, there may be another factor at work here. It could be that students are starting out with the intention to conduct academic research, but are finding themselves frustrated or distracted by the other offerings so readily available on the WWW.

The analysis comparing domain and "suitability for academic research" indicated low ratings for .com and .net, with higher values for .org and .gov (see Table 3). In fact, the most frequently visited domain name (.com) had the lowest educational value and one of the least frequently visited domain names, (.gov), had the highest educational value as determined by the evaluation of the media specialists.

Table 3
Mean Suitability for Academic Research of Sites by Leading Domain Names

Domain Name	(N)	Mean suitability for academic research as assigned by coders *
.com	(410)	1.59
.org	(25)	2.78
.edu	(16)	2.44
.net	(12)	1.75
.gov	(9)	3.0
.us	(5)	2.0
other	(23)	1.94

Note: * 1 = not suitable, 2 = questionable, 3 = suitable

Discussion

In order for educators and researchers to evaluate the benefit of WWW use by students in public schools it is necessary to begin by attempting to understand how students perceive the WWW, what they use it for, and what gratifications they receive during periods of access. This research explored the active and goal-directed use of the WWW by middle school and high school students in 10 public schools located in five public school districts. Consistent with the study's exploratory nature the results included the identification of gratifications sought from this new electronic interactive medium within a school setting. While this study did not provide answers to questions about the effect of WWW usage on student performance it did provide answers to a more fundamental set of questions. Two survey instruments were used to assess the following: students' affinity for the WWW, the amount of time spent using the WWW, students' self-assessed skill level, their beliefs about the relative value of the WWW as a source of both information and entertainment and as a means of communication, and their reasons for using or not using the WWW. And finally, student use of the WWW was monitored by sampling actual sites visited and by content-analyzing these sites for educational value.

Granted there is much excellent information available on the WWW. But as this study's content analysis of sites visited seems to indicate, students frequently are either not looking for it, or if they are, are unsuccessful in finding it. It is quite possible that users who approach a Web search with instrumental intentions may soon find themselves distracted by the entertaining and diverting offerings available. The ease with which one can travel to any corner of the vast Web can be both a blessing and a curse. And this is not a unique observation. A study of 6th and 9th grade science students found that without substantial guidance and assistance, students were often unsuccessful in locating useful academic information on the WWW (Lyons, Hoffman, Krajcik, & Soloway, 1997). According to the researchers, "one overall theme is clear from the data: students need a tremendous amount of support to be successful in online inquiry" (p. 12).

Commercialization of the WWW

The commercialization of the WWW and the growth of online advertising is another area of growing concern for educational technology advocates. The disproportionate use of commercial WWW sites by students in this study is just one indicator of the potential exposure of children to advertising. Students are often unaware of the questionable nature and value of information from commercial WWW sites. Lyons et al. (1997) found that students "often choose a commercial site (.com in the URL) over a government (.gov) or education (.edu) site" (p. 21-22), an observation supported by this research.

While unregulated advertising itself is cause for concern, the unique capability afforded by the WWW to collect user information and track usage raises even greater concern. The Zap Me corporation announced a program to give free computers with satellite-based Internet service to schools in exchange for the opportunity to include advertising in a corner of the monitor. In a New York Times article dated February 25, 1999, Richtel described the Zap Me system, which tracks the user's "grade level, sex and Zip code" in order to "dish out age and sex-appropriate advertisements" (p. G7). At the time of the article the company had "given computers to 55 schools in eight states." This kind of targeted advertising and the collection of user data for commercial purposes should be of concern not only to privacy advocates but also to educators and parents who are concerned about the negative effects of consumer-driven culture.

Socialization

More than a decade ago Rosengren and Windahl (1989) wrote,

today's moral panics about videos, cable, satellites, computer games and the like, may concern rather ephemeral phenomena. It may be true that for some time media novelties may have a capacity to spell-bind children, preventing them from other, perhaps better, activities. But it is probably also true that such an influence will be transient and will be greatly reduced or even vanish as the "new" media find their place in society. (p. 250)

While some of the moral panic spoken of by Rosengren and Windahl may have faded, it appears obvious that the "new" medium of the moment, the WWW, has simply attracted, and perhaps amplified, the concern that was once focused on the old media. According to Stephen Kerr, professor in the College of Education at the University of Washington,

The Net's beauty is that it's uncontrolled... It's information by anyone, for anyone. There's racist stuff, bigoted, hate-group stuff, filled with paranoia; bomb recipes; how to engage in various kinds of crimes, electronic and otherwise; scams and swindles. It's all there. It's all available... That's the antithesis of what classroom kids should be exposed to. (quoted in Oppenheimer, 1997, p. 61)

Concern about inappropriate material available on the WWW is one reason for the widespread use of acceptable use policies. Perhaps the issues of greatest concern focus on the presence of hate speech, sites promoting violent behavior and the means to carry out violent activities, pornography, and sexually explicit material. The unregulated nature of the WWW and its diversity of content providers serves to ensure the widest possible range of content. While other educational media are controlled by the school teachers and administrators who make decisions about what books, videos, and magazines to place in the media collection, the unfiltered WWW has been made available to students who frequently operate on an honor code of self-regulation.

Limitations

The most obvious limitation of this study is the sample and the methodology employed in its selection. Use of non-probabilistic sampling for schools chosen and self-selection of students taking the computer-administered surveys are acknowledged as restricting the generalizability of this study. Because of the non-random nature of the sample, generalization to the larger population of US adolescents is discouraged. However, this study aided in the identification of several motivations for use of the WWW at school and these offer heuristic value for future research.

As Charney (1996) found using a similar approach to study college students' use of the WWW, a complicating factor is that student use of this medium is confounded by use that has been assigned by a teacher. Unlike uses and gratifications studies of other media, use of the WWW, especially in a school setting, is a mixture of uses motivated by personal interest as well as those prescribed by authority figures. In this study there was no way to differentiate student use that was self-motivated versus use that was encouraged or even mandated by teachers.

Also, because of the need to protect the anonymity of respondents, students were not identified in a way that allowed comparisons between the two survey instruments. Neither were comparisons possible between the responses to the survey instruments and the content analysis of WWW sites visited by students. A research design that allowed for anonymous tracking of responses from one survey instrument to the next, and then tied WWW sites visited to a specific anonymous respondent, would have added heuristic value to the study.

On a related note, the analysis of sites visited by students did not take into account sites that were visited accidentally or for only a short period of time. It is quite possible that sites ranking low on "suitability for academic research" were visited only briefly while more suitable sites were visited for longer periods of time, or even printed for later use.

Conclusions

In the opening chapter of Failure to Connect, Healy (1998) stated: "Today's children are the subjects of a vast and optimistic experiment" (p. 17). Referring to the use of computers for educational purposes, Healy argued that computers raise more questions than they answer and concluded with a call for accountability and common sense. Cuban (1996) had a similar response and couched his assessment in an historical context.

First, techno-reformers' claims for what new machines can do are so inflated that public expectations continually get disappointed. Overselling has been (and continues to be) part of a familiar American cycle of creating a crisis, naming schools or teachers as a problem, and putting forward new machines (film, television, computers) as the best solution. Yet each technological innovation has had, at best, an uneven record in entering schools and classrooms. Why?

Based on this exploration of WWW use in school, several findings would appear to have policy implications for schools using or making plans to use the WWW for educational purposes. First, while students believe the WWW to be a valuable source of reliable information, their use of the WWW suggests other motivations. Analysis of sites visited indicated that by nearly a two-to-one margin students visited sites rated "unsuitable for academic research" versus sites rated "suitable." Seeking out "pleasurable experience" appeared to win out over "learning information" (Swanson, 1992) when students were given access to the WWW within the school setting. Furthermore, the types of sites visited most frequently, i.e., commercial sites, were rated as having the lowest educational value.

Also of note is the incongruity between students' self-reported use of the WWW and the uses suggested by the analysis of sites visited by students. Either students falsely reported their intentions or intervening variables affected the process of searching for and obtaining relevant information. One untested hypothesis to emerge from this study is that the best of intentions may be confounded by the ease with which students can access a myriad of competing sites that vie for their attention. Another possibility is that the students' understanding of research is more broadly defined and includes looking for content that has little or no relationship to traditional academic pursuits.

When it comes time to evaluate the appropriateness and effectiveness of media technology in the schools media effects researchers cannot have it both ways. Either media effects are real and the potential benefit of educational media must be balanced by constant vigilance against access to WWW sites that are at best a distraction and at worst a hindrance to the educational and social development of our children. Or, media effects are limited and mediated by user motives, attitudes, and use patterns, and any potential benefit of educational media in the schools is contingent on the proper psychological and sociological predictor variables. If this is the case, attention to these factors must be a top priority and WWW access must be implemented with the goal of creating the proper climate for learning to occur. In either case WWW literacy efforts-teaching students how to most effectively use the best resources on the WWW-are sorely needed. Since picking and choosing only the best WWW resources for students is not a viable option, giving students the tools to make wise decisions about media content is crucial.

Endnotes

1 According to Wartella and Reeves (1985) the first recorded instance of concern about media's effect on children was Plato's warning about storytellers in The Republic.

2 One could argue that Illich (1970) envisioned the WWW as an educational resource long before its time when he wrote, "The current search for new educational funnels must be reversed into the search for their institutional inverse: educational webs which heighten the opportunity for each one to transform each moment of his living into one of learning, sharing, and caring" (pp. xix-xx, emphasis in the original). Illich continued, "We need research on the possible use of technology to create institutions which serve personal, creative, and autonomous interaction and the emergence of values which cannot be substantially controlled by technocrats. We need counterfoil research to current futurology" (p. 2). In describing an alternative to school, Illich might have been describing the modern listserv or chat forum: "The most radical alternative to school would be a network or service which gave each man [sic]the same opportunity to share his [sic] current concern with others motivated by the same concern" (p. 19). The great difference, however, between what Illich envisioned and what WWW advocates are promoting is the locus of responsibility.

3 For the full study, including survey instruments, see Ebersole (1999).

4 It is interesting to note that the list of "uses" is similar those found by researchers exploring the uses and gratifications of "old" media. Information, entertainment, social utility, passing the time, and other traditionally defined uses of the media are present with some distinctions made possible by the interactive nature of this new medium.

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Responsive Instructional Design: Scaffolding the Adoption and Change Process

Peggy A. Ertmer
Purdue University

According to the most recent report of the National Center for Education Statistics (NCES, 2000), 99 percent of all public school teachers now have access to computers or the Internet in their schools. However, despite this growing presence of technology, teachers all over the country continue to grapple with both practical and philosophical problems posed by the integration process. Nearly 70 percent of teachers still report not feeling well prepared to use computers and the Internet in their teaching (NCES). According to the 1998 Technology in Education Report (Market Data Retrieval), only 7 percent of schools, nationwide, boast a majority of teachers at an advanced skill level (i.e., able to integrate technology into the curriculum). Even among our newest teachers, instructional use is not as high as might be expected. Although beginning teachers report wanting to use computers, they often find it difficult to do so when so much of their time is consumed by the routine tasks of teaching and managing their classrooms. The use of computers, then, becomes an extra task which, although seen as important, is of lower priority than more basic activities (Hruskocy, 1999; Novak & Knowles, 1991).

Clearly, the growing increase in teachers' technical skills is insufficient to guarantee the effective use of technology in the classroom (Carvin, 1999; Marcinkiewicz, 1994). Through previous research efforts (Ertmer, 1999; Ertmer, Addison, Lane, Ross, & Woods, 1999; Ertmer & Hruskocy, 1999; Hruskocy, Cennamo, Ertmer, & Johnson, 2000) we have identified a number of challenges that teachers face as they begin to integrate technology within their curricula. Besides a host of technical and logistical questions (e.g., How does this software package work? Where and when should we use computers?), more subtle issues, related to teachers' pedagogical visions and beliefs, as well as their perceived confidence for using technology, are also known to impede meaningful classroom use.

Assuming that most designers and staff developers are fairly well-prepared to provide technical skills training for teachers *who want it* and *are prepared to learn from it*, this paper focuses instead on how designers might work with teachers who either don't want training or are not prepared to learn from it, or both! This paper, then, emphasizes the role that teachers' beliefs play in the adoption and change process and specifically discusses how those beliefs might be addressed through teacher development efforts. Elsewhere (Ertmer, 1999) I have described how teachers' beliefs may function as second-order barriers to change (i.e., barriers that are intrinsic to teachers and that challenge fundamental beliefs about current practice). Again, I am assuming that designers are capable of helping teachers deal with first-order barriers, those that are extrinsic to teachers and which include skills training and equipment needs. Even if these assumptions are false, second-order barriers are still likely to present the biggest challenges to those charged with coaching/assisting reluctant teachers/adopters.

Teacher Beliefs

In summarizing research on teachers' beliefs, Pajares (1992) noted that "there is a strong relationship between teachers' educational beliefs and their planning, instructional decisions, and classroom practices" (p. 326). In particular, teachers' beliefs about their *ability to use computers* in instruction may be key, given the role self-efficacy is proposed to play in determining behavior. In a recent study by McKinney, Sexton, and Meyerson (1999), participants with lower efficacy beliefs expressed concerns typical of those in an early stage of change (self-concerns) while those with higher efficacy had concerns that were more characteristic of later stages of change (impact-concerns).

Self-efficacy refers to personal beliefs about one's capability to learn or perform actions at designated levels (Bandura, 1997). According to Bandura, self-efficacy is based, not solely on the level of skill possessed by an individual, but on judgments about what can be done with current skills. As such, self-efficacy is thought to <u>mediate</u> the relationship between skill and action. Simply put, without skill, performance isn't possible; yet without self-efficacy, performance may not be attempted. According to Bandura, "beliefs of personal efficacy constitute the key factor of human agency" (p. 3). Thus, teachers who have high levels of efficacy for teaching with technology are more likely to participate more eagerly, expend more effort, and persist longer on technology-related tasks than teachers who have low levels of efficacy.

So what does this mean to designers and others who are responsible for teacher development? How can we design professional development experiences that address teachers' second-order barriers, or more specifically, that build teachers' efficacy for using computers in instruction?

Addressing Efficacy Beliefs through Design Efforts

Consider the following scenario: A new principal has just assumed leadership of the local high school and has some fairly strong ideas about how technology should be used within her school. The high school building is well-equipped, having all the necessary resources. The principal approaches you, as an instructional designer, to help her people get up to speed. She admits that many of her staff are not convinced of the need for technology in their teaching, but believes that if you present a few good reasons why technology should be used, they will jump on board. Where do you begin?

Researchers in the area of self-efficacy (c.f., Schunk, 2000) describe four primary sources of information that can influence judgments of efficacy: vicarious experiences (observing models), social persuasion ("I know you can do this!"), physiological indicators (emotional arousal, relaxation), and personal mastery (successful task completion). However, teachers may be more or less influenced by each source of information depending on a host of other factors--their current skill level, their beliefs about teaching and learning, their attitudes towards computers in general, and so on. For example, providing models of exemplary users may not be effective for teachers whose confidence and skill levels are at the low end of the continuum. In fact, the use of this type of efficacy information may prove detrimental for teachers who can't imagine ever attaining these high levels of use (Snoeyink, 2000). Instead, teachers with low skill and confidence levels may need to experience a few small-scale successes in order to establish even an *initial* level of efficacy.

Acknowledging that teachers in any given school are likely to represent a range of levels of confidence, skills, and teaching beliefs, designers can not expect to implement a one-size-fits-all training program. Still, within each stage of development (novice - expert), growth in one area is likely to be related to growth in other areas. Thus, by increasing confidence, skill, or a change in beliefs, we may be able to support teachers' efforts toward adoption and use. Certainly, growth in skill and growth in confidence have been demonstrated to be positively correlated (Ertmer, Evenbeck, Cennamo, & Lehman, 1994). Furthermore, there is some evidence to support the idea that pedagogical beliefs and technology use are also related (Becker & Riel, 1999) and that as teachers use technology more their beliefs become more constructivist-oriented (Dwyer, 1996).

Consider the following teachers who are likely to comprise part of the teaching staff at the local high school:

Teachers with low skills and low confidence. Low skills and low confidence typically translate into resistant or reluctant teachers who see no reason to initiate change in their classrooms. Trying to convince these teachers that they need to use technology is pointless; strategies that worked to convince early adopters are not likely to work with late adopters. According to Moore (cited in McKinzie, 1999), "crossing the chasm between these groups (early and late adopters) requires a mammoth campaign that includes special attention to the vastly different needs, perspectives, and demands of the late adopters." Whereas social persuasion may be a great strategy for convincing early adopters, this strategy usually won't work with late adopters.

Neither is it likely that teachers at this level will be swayed through vicarious experiences, or observing successful others. Teachers at this level are not ready to embrace, or even consider, technology integration ideas. Although many educators have suggested that technology training efforts should focus on the conceptual and pedagogical levels (Carvin, 1999; Clouse & Alexander, 1997), others disagree (Milone, 2000; Snoeyink, 2000). Stapel (cited in Milone) explained, "In the past, I think we made a mistake by rushing too quickly into the integration phase of staff development. In many cases, teachers just weren't ready" (p. 58).

Of the four techniques recommended for increasing self-efficacy, personal mastery is likely to be the most beneficial for novice computer users. Experiencing even small success can increase confidence. Furthermore, establishing relevancy may convince reluctance users to "have a go." A designer in the situation described earlier might begin with the teachers' own personal or instructional needs as one way to create relevance. Perhaps the teacher has a nephew or a grandchild who is having a birthday--would she like to send a virtual bouquet? What particular classroom issues are consuming the teacher's time? Could technology ease some of the load by allowing her to easily modify newsletters or student progress reports or calculate weighted grades? Is there a particular concept that is hard for her students to grasp that could be demonstrated through a simulation? The idea is to find out what the teacher needs and then collaboratively develop a plan that efficiently meets those needs. Similar to the idea of creating an individual educational plan (IEP) for each student, a designer might consider co-creating an individual teaching/technology plan (ITP) with each teacher. As with any good instructional design, designers are advised to start with what teachers know and then use strategies that meet their unique learning needs.

Teachers with medium skills and medium confidence. Teachers at this level have typically achieved some level of competence with technology but may not have found the desire or means to bring these tools into the classroom. Because they teachers have at least an initial level of confidence, they may be at a point where they will benefit from observing similar others who have achieved higher levels of use. These applications no longer seem out of reach for these teachers and may now serve as inspiration. Training emphases and methods that were appropriate for novice technology users (step-by-step procedures, skill building) are not likely to be as effective for intermediate users. Teachers at this level may benefit from shadowing similar others, do-it-yourself manuals, and collaborative efforts. While skills will need to be continually refined and updated, it's not as important to focus development efforts strictly on skills; skill instruction can now be embedded within meaningful projects or relevant tasks.

Teachers at a medium skill level are probably just starting to imagine some specific classroom applications and may not be able to extrapolate from ideas used at other grade levels and in other content areas (Snoeyink, 2000). Thus, it may still be important at this level to include concrete ideas for the teacher's grade level and content area. A designer charged with helping teachers at this level will need to have a strong working knowledge of various curricular standards, or have ready access to someone who can help translate these standards into workable technology solutions. Unfortunately, this is not nearly as easy as it sounds.

Responsive Instructional Design

In the following section, I propose a model of teacher development that builds on, and responds to, teachers' unique needs, specifically those with lower levels of skill and confidence. I propose that this model represents a responsive approach to instructional design; that is, training needs are described in terms of users rather than instruction, and instructional decisions are based on users' goals and needs, not those of designers or instructors. Although the model is similar to the ADDIE approach, each step requires that more attention be paid to users' perceived needs and goals. This suggests a greater need for both communication and analysis skills. Steps in the model are described below.

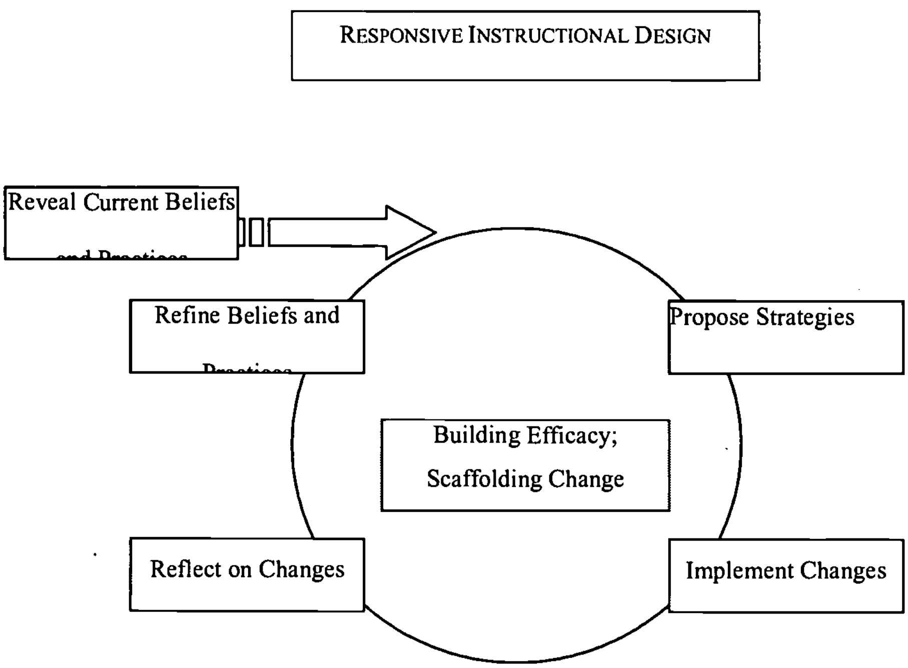

Figure 1. A Model for Responsive Instructional Design

Reveal. Responsive instructional design is based on the assumption that teachers are more likely to embrace pedagogical and classroom change if these changes address the real issues they face in practice. Teachers are encouraged to reveal the goals they want to accomplish in their classrooms, the barriers that hinder their work, and the instructional and/or administrative concerns they have, *unrelated to technology*. Teachers also are asked to

reveal their beliefs about teaching as well as the incentives that motivate them to teach. At these early stages of technology adoption and use, the focus is not on technology skills or needs. Teachers are encouraged to consider their needs as both teachers and learners prior to considering their needs as technology users. Teachers and designers work collaboratively to develop an individual teacher profile, followed by the development of an individual teaching/technology plan (ITP) in the next step. Thus, an individual teacher profile might include information about teachers' 1) classroom practices, 2) classroom context, 3) perceived issues and barriers, 4) beliefs about teaching, 5) motivation for teaching, as well as 6) preferred ways of learning and teaching. By beginning with teachers' perceived needs, we remove the focus from the innovation and place it instead on teaching practices and the important issues teachers face.

Propose. During this step, teachers and designers co-develop an individual teaching/technology plan by considering various means for meeting specific needs identified in the teacher profile. After reviewing the issues teachers face, designers help translate these important questions into technology-based learning opportunities. Depending on the type of support teachers request or require, different types of support should be offered (one-on-one consulting, just-in-time training, formal classroom training, peer collaboration and observation, etc.). Some strategies will work more readily and be more appealing than others, depending, at least to some extent, on the barriers teachers describe. Different barriers (e.g., lack of confidence vs. lack of support) typically suggest the use of different strategies. For example, if teachers mention not yet feeling comfortable with technology, they probably are not ready to begin using technology in the classroom. Instead, they need to increase their personal comfort through increased individual and personal use. By acknowledging and helping teachers work through specific first- and second-order barriers, we help them identify strategies that work for them and simultaneously build confidence in their ability to address future barriers.

Implement. As teachcrs' test their ideas in their classrooms, they experience first-hand what works and what doesn't. As Maddin (1997) emphasized, "the real learning begins in your classroom" (p. 56). Information obtained through direct experience is one of the most powerful means to shape future practice. Because self-efficacy is a fluid construct, it changes with new experiences. While early success can raise efficacy, early failures may lower it. For this reason, it is probably important that reluctant teachers experience as much success as possible during their first few attempts to use technology within the classroom. Additionally, teachers should set realistic goals for themselves since they will measure their success by how closely they meet the goals they have set (Pintrich & Schunk, 1996). It is not critical that reluctant teachers implement a highly sophisticated lesson with lots of bells and whistles. What's most important is that they are successful. Risk and surprise need to be eliminated, or at least greatly controlled.

Reflect. Kagan (1992) explained that changes in teachers' beliefs are rarely the result of reading and applying research findings. Teachers base most of their ideas on their own and others' experiences. In order to promote professional growth in novices, Kagan recommended that teachers' awareness of their own beliefs be raised followed by experiences that challenge those beliefs and promote integration of new ideas into current belief systems. Such reflection initiates the revision process. After implementing new ideas or tools in the classroom, the teacher takes time, with or without the designer, to reflect on the teaching/learning processes and outcomes achieved. Teachers consider how the teaching and learning that occurred compared to what was expected. As teachers realize that their "ability to successfully utilize technology has increased, they are motivated to attempt to learn more about technology, it's uses, and benefits" (George & Camarata, 1996, p. 51). However, as with most teaching experiences, there are usually many opportunities for improvement. Teachers should be encouraged to focus their reflections primarily on what the students did or did not do in response to the lesson. Based on this information, teachers can consider what changes need to be made to effect the types of student performances or levels of thinking desired.

Refine. In this final step, teachers are encouraged to discuss their instructional changes with others and consider the overall usefulness and effectiveness of the changes they have initiated. Based on conversations with others, teachers are encouraged to outline their next steps for development. This may include implementing a revised version of the lesson, adding one more idea to the lesson, or reading relevant literature to examine what others have done. Revisions made after each iteration are not likely to be substantial; however, continual refinements, over time, can add up to noticeable differences. As teachers continue to converse with others about how they addressed a relevant issue in their classrooms, as well as the results they obtained, they initiate, in effect, new cycles of development.

Relationship of Model to Current ID Practices

Designers who have been trained to design programs/instruction using the instructional systems approach already have the basic tools they need to work with teachers and students in a responsive manner. For example, using analysis tools, we determine teachers' goals for their students, their classrooms, and themselves. We identify the specific supporting (or limiting) contextual factors in the environment in which teachers currently apply their skills. As part of a learner analysis, we identify teachers' current levels of skills and confidence. Given these goals and current skills, we determine the gap that exists, and then identify specific needs that must be met. As part of the design and development process, we devise instructional strategies, materials, and job aids that will meet teachers where they are and start to move them forward toward the goals they have identified. As teachers implement new skills within their classroom practice, we have the opportunity to co-reflect on what is working and what is not, and to make adjustments (in both training and implementation) to better achieve the intended outcomes. Ongoing evaluation allows teachers and designers to determine the effectiveness of selected approaches and to make revisions that bring us closer to our mutual goals.

Even though the design steps for the ADDIE and the responsive ID models are similar, designers need to be aware of critical differences, including the different starting points and the increased involvement of the end-users. To summarize, some specific suggestions for instructional designers who intend to assist teachers with their technology efforts include:

1) Ask teachers about their visions and goals for their classrooms. What do they want to be able to do? What are their priorities for teaching and learning?

2) Listen to teachers' specific needs. What kind of barriers do they encounter? What do these barriers suggest about their readiness for technology use and the strategies that may be needed to assist them at different levels?

3) Co-create flexible solutions. Be prepared to meet changing needs. Be sure that problems and solutions are rooted in teachers' work. Use the reveal-reflect-refine cycle described above.

4) Adapt innovations to fit teachers' needs. Teachers are great adapters--help them locate and select programs or software that will work for them and their particular set of students.

Conclusion

A number of researchers have suggested that training strategies should be varied to meet the needs of teachers at different levels of technology use (Dwyer, Ringstaff, & Sandholtz, 1991; Sherry, Billig, Tavalin, & Gibson, 2000). Given the long-term nature of the integration/adoption process, it is recommended that staff developers/instructional designers meet implementation needs in a responsive fashion--that is, through "iterative interventions" (Frame, 1991) that meet and challenge individual teachers at their current levels of use. As teachers face changing needs, the strategies designed to meet them must also change. Furthermore, different strategies are likely to be more or less effective for people with different levels of efficacy. It is important not to discourage teachers who have low levels of confidence by surrounding them with others who are much more experienced and confident. By designing development programs that start with the concerns that these teachers have, and helping them experience some initial success in solving their own problems, we have a better chance of making headway in the adoption process.

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Assessing Adaptive Instructional Design Tools and Methods in ADAPT^{IT}

Deniz Eseryel
University of Bergen, Norway

J. Michael Spector
Syracuse University

Abstract

ADAPT^{IT} is a European project within the Information Society Technologies programme that is providing design methods and tools to guide a training designer according to the latest cognitive science and standardisation principles. Adapt^{IT} addresses users in two significantly different domains within the aviation industry: aircraft maintenance training and air traffic control training. Because these two subject domains are quite different and those who perform associated tasks also differ in significant ways, it is our hypothesis that outcomes will generalise to other complex domains and users. The methods integrated into ADAPT^{IT} are based on van Merriënboer's (1997) four component instructional design model. This paper reports the needs assessment procedures and outcomes associated with the effort and indicates how they are informing the evaluation plan.

Introduction

ADAPT^{IT} is a European project coordinated by the Dutch National Aerospace Laboratory (NLR). The effort falls with the European Commission's Information Society Technologies programme (IST; see http://www.cordis.lu/ist/ for additional details) and includes as partners: NLR, the Open University of the Netherlands, the University of Bergen, Seven Mountains AS, EuroControl, the Swedish Air Traffic Control Academy, and Piaggo Aerospace. The project began in January 2000 with an extensive needs assessment of training designers within the aviation industry and in other business and industry sectors that involved training of complex skills. The early literature review and training requirements analysis indicated that the most appropriate and relevant methodology was the four component instructional design model (van Merriënboer & Dijkstra, 1997). Before discussing the ADAPT^{IT} needs assessment and its implications for implementation and evaluation, we would first like to orient the reader with a brief overview of the European Commission's research programmes and IST.

The European Commission's Fifth Framework research and development programme extends from 1998 through 2002. IST is a single, integrated research programme within that framework that builds on the convergence of information processing, communications and media technologies. IST has a budget of approximately 3.6 billion Euro, and is managed by the Information Society Directorate General of the European Commission (one of 20 commissioners in the EC). The strategic objective of the IST is to realise the benefits of the information society for Europe both by accelerating its emergence and by ensuring that the needs of individuals and enterprises are met. It is managed by the European Commission, with the assistance of the IST Committee consisting of representatives of each Member and Associated State. The Commission and the IST Committee are supported in their work by an IST Advisory Group of some 25 members who are highly experienced in this field. They provide independent expert advice concerning the content of the IST work programme, which includes research and development.

The IST Programme has four inter-related specific objectives concerning individuals, enterprises, multimedia technologies and enabling technologies. For the private individual, the objective is to meet the need and expectation of high-quality affordable general interest services. For Europe's enterprises, workers and consumers, the objective is to enable individuals and organisations to innovate and be more effective and efficient in their work, thereby providing the basis for sustainable growth and high added-value employment while also improving the quality of working life. In the sector of multimedia content, the key objective is to confirm Europe as a leading force, realising its full potential. For the enabling technologies, which are the foundations of the information society, the programme objective is to drive their development, enhance their applicability and accelerate their take-up in Europe.

ADAPT^{IT} addresses all four objectives but is tightly focussed on instructional design methods and tools as a critical enabling technology. The next section contains a brief overview of the effort, the approach taken and the associated work plan.

Advanced Design Approach for Personalised Training-Interactive Tools (ADAPT^{IT})

The overall goal of this effort is to create and validate effective training design methodologies, based on cognitive science and the integration of advanced technologies, so that Europe can better meet the many challenges of the information society of the 21st century. The aviation industry is targeted for this research and development effort as it is a key industry in which Europe has been an active leader. Two quite different training areas (air traffic control and aircraft maintenance) are involves so as to insure generalisability of the methodology and tools to other subject areas and industries.

This project bridges the gap between complex training problems and new technological possibilities by developing and validating a training design framework to guide the use of state-of-the-art cognitive approaches within advanced training systems. A central requirement for the design methodology is that it provide for development of a personalised training and education trajectory. This includes a specification of training models that account for and adapt to trainees' performances, attention strategies, and workload. Another important requirement for efficient training of flexible skills for complex tasks is to maintain a close and natural relationship between knowledge learning and skill acquisition activities for both individuals and teams (van Merriënboer, 1997; van Merriënboer & Dijkstra, 1997).

This project is developing a personalised training design methodology, providing associated design tools for efficient realisation of that methodology, and validating the methodology in different training domains and with different trainee-levels. The validation will be performed in the context of aircraft maintenance and air traffic control. Current challenges for aviation training relate to the increasing complexity of dynamic task environments, increasing time constraints, and increasing demands for cognitive and information-managing tasks. As technology takes over or automates many basic tasks and adds functionalities to operational systems, the result is that more demand is placed on humans to perform higher level and supervisory tasks. The problems within aviation training are exemplary of highly complex and automated task environments that require flexible skills and are likely to forecast training problems in other professional domains.

The project proposal is for 36 months beginning January 2000, with an estimated total of 175 person-months required for completion. The effort is broken into these 9 work packages:

1. Project management
2. Literature search
3. Design needs analysis
4. Specifications for method and tools
5. Development of method and tools
6. Validation of the design process
7. Validation of the learning process
8. Standardisation
9. Integration, final report and recommendations

Validation partners from the aviation industry (Piaggio, EuroControl, and the Swedish Air Traffic Control Academy) will directly benefit from the training design methodology and associated tools. These partners provide a real-world setting and associated support for testing the design, development, and validation of the design methodology and training developed according to that methodology. The design process is user-centered and involves the validation partners throughout the process. The process is iterative so that initial designs, methods, and tools can be refined in close association with the requirements and needs of the targeted industry users and beneficiaries. At the end of the effort, the validation partners will have in place validated training modules as well as a cadre of training design specialists knowledgeable and skilled in the use of the newly developed design methodology and tools.

Training Design for Complex Cognitive Skills

One of the major aims of ADAPT^{IT} is to create a harmonised training-design tool for dealing with tasks requiring complex cognitive skills, which can be defined as "skills for which the learner must invest considerable time and effort to acquire an acceptable mastery level and for which qualitative differences in performance exist between novices and experts" (van Merriënboer & Dijkstra, 1997, p.427). Training of complex cognitive skills are becoming increasingly important in today's society where routine tasks (recurrent skills) are mostly automated by machines. As a consequence, complex cognitive tasks, which cannot be taken over by machines, form the basis of training needs in industry. Examples of such complex cognitive skills are air traffic control skills, fault-management

skills, and computer-programming skills. One of the main characteristics of such skills is that their acquisition is a lengthy and effortful process. In other words, they are hard to learn. There are many constituent skills involved and at least some of those constituent skills involve problem solving and qualitative reasoning, requiring a deep understanding of systems and processes. In addition, the ability to integrate and coordinate the constituent skills involved is critical to reaching acceptable performance. Traditional instructional design models (e.g., Dick and Carey, 1996; Gagné, Briggs, & Wager, 1992) are particularly weak when it comes to the design of training programs for the multidimensional, complex learning required in highly demanding technical domains (Schneider, 1985). Other alternative models, while useful at a high level, are typically too generic and fail to provide specific guidelines (e.g., Gustafson & Branch, 1997; Tennyson, 1995) or there haven't been validated in the aviation industry (e.g., Kieras & Polson, 1985). Therefore, the ADAPT[IT] methodology is based on van Merriënboer's Four-Component Instructional Design (4C/ID) model. The 4C/ID model involves a training design method that has been empirically validated in the aviation industry (van Blanken & van der Pal, 1999). This method is scenario-based and makes the acquisition of complex cognitive technical skills the primary target and foundation of the training analysis and design method.

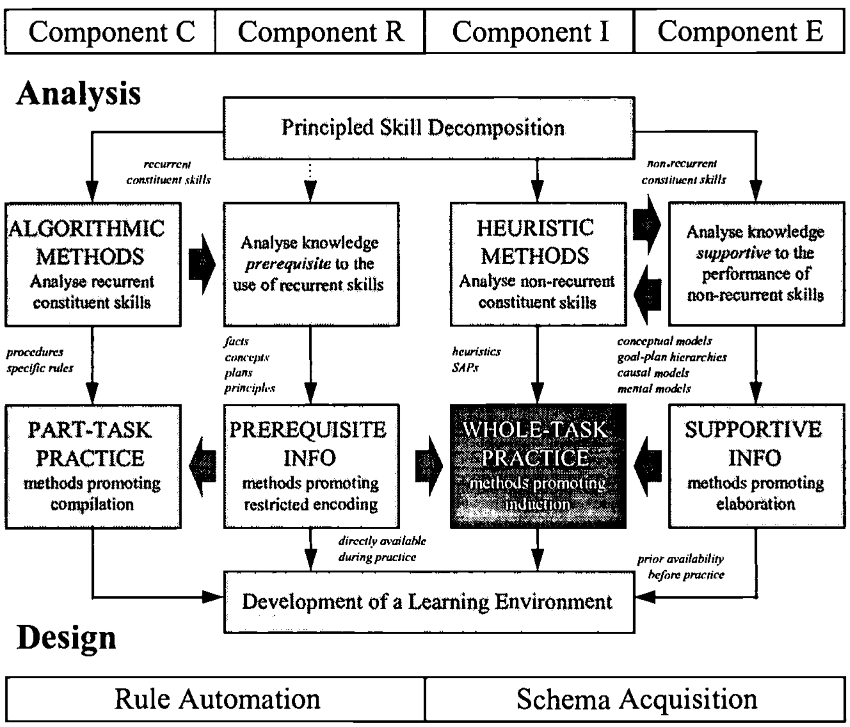

Figure 1. Overview of the 4C/ID-model, adapted from van Merriënboer (1997).

The model's systematic approach to the development of training is represented in Figure 1. The model provides guidelines for the design of training programs in highly complex domains and consists of four layers: (1) principled skill decomposition; (2) analysis of constituent skills and related knowledge; (3) selection of instructional methods; and, (4) development of a learning environment. These layers prescribe and contextualise the activities that instructional designers should perform in order to produce effective training for complex cognitive skills. Layers 1 and 2 involve the analysis of a complex cognitive skill; layers 3 and 4 involve the design of a training strategy and learning environment for that skill. It should be noted that although the layers are represented in a linear order, real world applications are much less well-ordered and often involve iterations. Tennyson (1995) also emphasizes this, as well as the associated contextualised activities of designers.

Ideally, the application of the model starts with principled skill decomposition, where the complex cognitive skill is decomposed into a hierarchy of its constituent skills and categorized according to their desired exit behaviours and related types of learning. This phase assumes that a proper needs analysis has been conducted and

the general goal or terminal objective of the training has been identified. Briefly speaking, in the principled skill decomposition phase, this general goal is further decomposed into a skills hierarchy that reflects the more specific constituent skills that enable the performance of the whole skill. The general idea of such a skill hierarchy is that "learning the constituent skills lower in the hierarchy might facilitate the learning or performance of the skills higher in the hierarchy" (van Merriënboer, 1997, p.86). The creation of hierarchies has been a long-standing practice in many instructional models (Dick & Carey, 1996; Gagné et al., 1992), but this particular hierarchy is focussed entirely on complex cognitive skills.

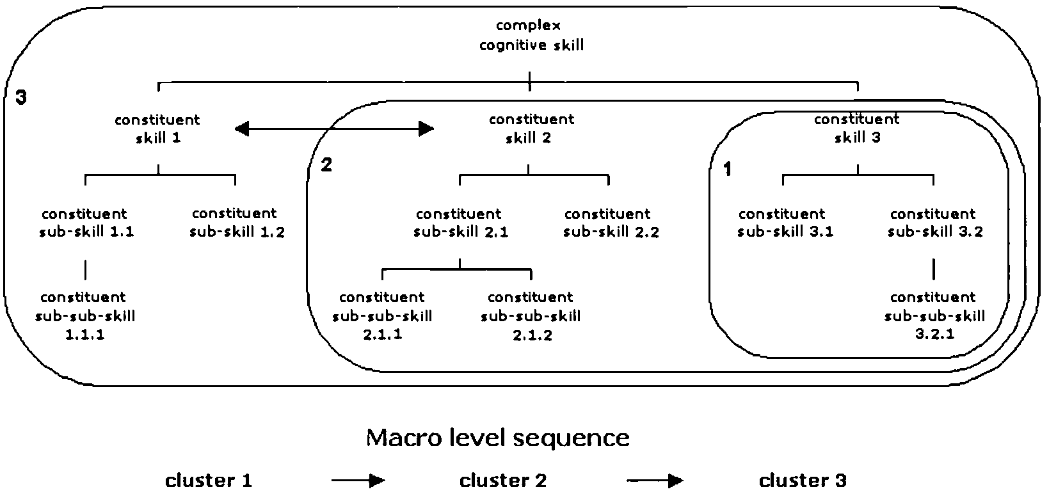

Figure 2. Generic example of a skills hierarchy and its division into skill clusters

For many tasks, all of the constituent skills of the complex cognitive skill cannot be trained simultaneously, so the skills hierarchy is divided into clusters. This clustering is called macro-level sequencing. The clusters may be seen as "parts" of the complex cognitive skill and each cluster contains a fairly large, meaningful set of interrelated constituent skills. Each cluster may require from 20 to 200 hours of training. Also, every cluster of subskills should represent an authentic task that an expert would perform in practice. Figure 2 shows an example of a skills hierarchy and how it used to form skill clusters. At the top of the hierarchy is the complete complex cognitive skill. The downward links represent the skills that are prerequisite for mastery of the skill above. For example, to be able to perform skill 2, one should be able to perform subskills 2.1 and 2.2. From left to right, a temporal order is depicted. For example, for the complete performance of skill 2, one first performs skill 2.1 and then skill 2.2. Skills on the same level that are connected with a double arrow are performed concurrently. In the example, a backward chaining approach is applied to order the skills clusters. This means that the cluster of skills that is trained first is the cluster that is usually performed last when an expert performs the complete complex skill.

Once the constituent skills are described along with performance objectives, categorized (recurrent, non-recurrent), and sequenced, the next layer in the model deals with the analysis of those identified constituent skills, relationships between them, and knowledge structures underlying the performance of the complex cognitive skill and its constituent skills. This analysis primarily refers to the procedures or rules that underlie expert knowledge. Briefly, in this phase four different analysis takes place: (1) analysis of recurrent constituent skills as strong methods; (2) analysis of non-recurrent constituent skills as weak methods; (3) analysis of prerequisite knowledge to perform recurrent skills; and, (4) analysis of supportive knowledge to perform non-recurrent constituent skills. Different task analytical techniques are prescribed by the model for each of these analyses (van Merriënboer, 1997). It is important to note that this layer translates into meso-level sequencing which specifies the order in which case types (i.e., categories of problems or worked-out examples) should be included in the training sequence for the skill clusters defined during macro–level sequencing. In other words, this sequencing provides a first global blueprint for the contents of a training program, providing a sound basis for the subsequent design of a learning environment. The outcomes of the analysis conducted in this second layer are heuristic methods - systematic approaches to problem solving (SAP charts). These charts that indicate: the sequence of non-recurrent skills; the supportive knowledge

involved; rules and procedures for performing recurrent skills; prerequisite knowledge required to be able to perform procedures and apply rules; and sets of case types in a progression of simple to complex versions of the whole skill within the cluster.

After analysing the complex cognitive skill and each of its constituent skills, the training strategy should be composed. This coincides with the third layer in the model, where instructional methods for the design of whole-task and part-task practice as well as for different types of information presentation before and during practice are specified. Again four different activities take place depending on the category of the constituent skills at hand: whole-task practice, supportive information, prerequisite information, and part-task practice. The design of whole-task practice, in this layer, mainly refers to specifications of examples (problems and their solutions) and problems (incomplete examples) that the learners will be confronted with during training. This process should aim at promoting "a rapid development of highly situation-specific, automated rules by knowledge compilation. Instructional methods that are suitable for to reach this goal are often associated with repeated imitation and drill; learners are invited to mechanically and consistently repeat performance" (van Merriënboer & Dijkstra, 1997, p. 437). The key learning process to be promoted is induction - mindful abstractions of cognitive schemata that are useful to solving problems in the domain of interest. This is based on the premise that giving learners examples helps them construct mental frameworks that they can use when encountering similar problems in the future. The design of whole-task practice results in the first blueprint of the training program, describing what the learners will be required to do during the training. Figure 3 depicts the basic blueprint of a training program resulting from macro-level, meso-level, and micro-level sequencing. From the viewpoint of the designer, it is basically a hierarchy with the complex skill at the top followed by three sequencing levels: (1) skill clusters; (2) case types; and, (3) specific whole-task problems. This basic skeleton serves as the backbone for other design activities where additional practice for recurrent constituent skills and information is presented in order to support the acquisition of either non-recurrent or recurrent constituent skills. In other words, the training program blueprint is a hierarchy of:

- *skill clusters* ("whole tasks" - macro-level sequence);
- *case types* (the simple-to-complex cases of the whole task - meso-level sequence); and,
- *specific problems* (the problems or worked-out examples in each type of case and in each skill cluster - micro-level sequence).

This basic blueprint as presented in Figure 3, is then further elaborated to reach a complete description of the training program with the other activities in the third layer, which provide:

- additional part-task practice that may be necessary to reach the required exit behavior for particular recurrent constituent skills (part-task practice);
- information that is prerequisite to the performance of recurrent constituent skills, as performed either in a whole-task or part-task context (prerequisite info/JIT presentation); and,
- information that may be helpful to the performance of non-recurrent constituent skills, which are only performed in a whole-task context (supportive info for elaboration and understanding).

The model further provides detailed guidelines for instructional strategies and tactics for the presentation of information for each of the four components: whole-task practice, part-task practice, just-in-time information, and supportive and strategic information that need to be elaborated by the learners (van Merriënboer, 1997). Once, appropriate strategies and tactics are selected in the third layer, the designer moves to the fourth layer to compose a training strategy containing the selected instructional methods; this process results in a detailed blueprint for the learning environment. This layer prepares the designer for the transition from the design phase to the development phase. Since 4C/ID is an instructional design model, not an instructional development model, it does not provide detailed guidelines for the development of instructional materials. The model should be integrated with and embedded in an instructional development model during its implementation.

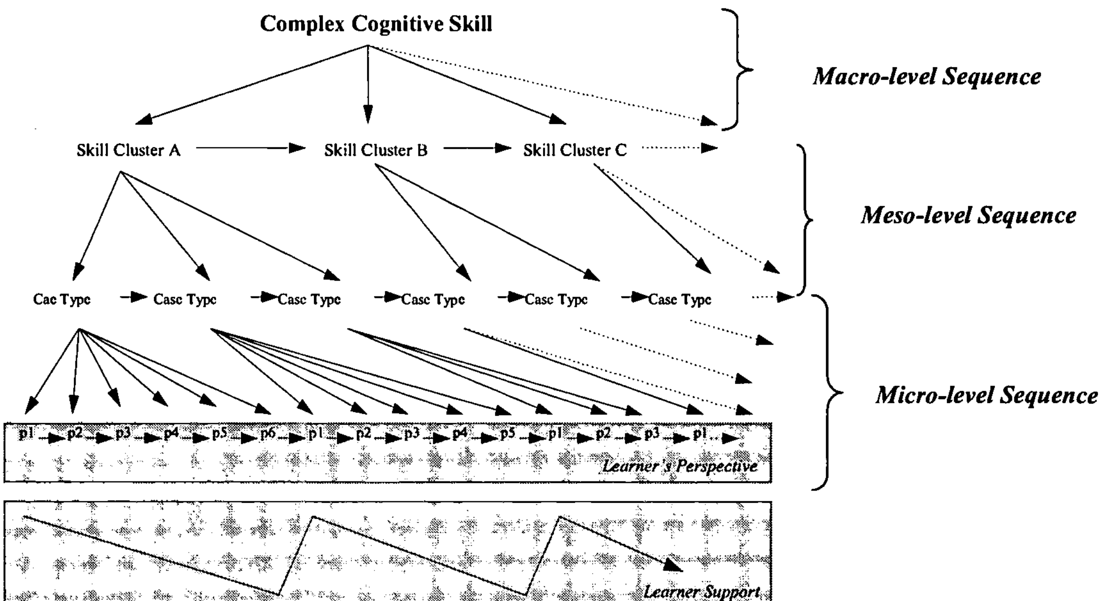

Figure 3. A generic blueprint for the training program showing the skills hierarchy, adapted from van Merriënboer (1997).

Overall, the ADAPT system aims at this integration. The result be a more time-effective instructional design process that increases the possibilities for re-usability of intermediate design products. Within the system, the ADAPT method that will guide the design phase will be based on the 4C/ID model just described but also integrate models of workload for aviation training development. In order to reach sufficient levels of standardisation and generality, designers will be supported in the proper and efficient use of the methodology by means of an interactive computer-based tool - automated instructional design support - ADAPT^{IT}. One of the innovative aspects of ADAPT^{IT} is that it will assist designers and design teams in decomposing and analysing a complex skill to-be-taught in such a way that alternative learning tasks can be developed that vary on the degree of cognitive load imposed on the learner. The ADAPT method will address the whole range of training design while including the aspects of 'intelligent tutoring' that relate to cognitive load theory.

Training Designer's Needs

Although the ADAPT methodology will be mainly based on the 4C/ID model it will be different from the 4C/ID method in two ways. First, it will be tailored to the needs of actual designers or design teams in a variety of training domains, economical sectors, and company sizes. Second, it will be extended to become a personalised training approach. In order to achieve the former, current practice in designing training for complex cognitive skills had to be identified. The project team realised this through three different data sources. First, the literature on training designer's needs was reviewed. Training designer's needs are defined as the requirements that have to be met in order to change and improve current design practice. These requirements refer primarily to instructional design practitioner's perceived needs for support to use and apply instructional design theories and models. In addition to the literature review, designer's needs were identified by means of questionnaires and interviews. The design of the questionnaire was a collective effort based on focus groups with project and subject experts. It consisted of the following sections:

1. Background information (information on the company and the responding designer);
2. Outcomes of training (the tasks, skills, knowledge and attitudes for which training is designed);
3. Training design method (the products of the training design process, both intermediate and final);
4. Instructional design tools (the tools that are used to design training); and,
5. Desired tool characteristics (the ideal characteristics and functionality that respondents would like to have).

A total of 150 questionnaires were sent out by targeted e-mail, and 18 were returned. The respondents came from different sectors: education, transport, business, and manufacturing. In addition to the questionnaires, extensive

interviews with training designers were also conducted in order to gather more detailed information on current training design practices, the problems that are encountered and the desired support and specific needs during the training design process. The interview consisted of the following sections:

1. General information (information on the company and the interviewee);
2. Training design process (the training design process in general and the products of the training design process - both intermediate and final products);
3. Training design characteristics (the content of the training, the instructional principles used, etc.);
4. Co-operative design and design teams (the structure of a design team, the disciplines involved in a typical design team, the way in which a typical design team works, etc.); and,
5. Instructional design tools (the tools that are used and ideal characteristics of an instructional design tool).

Each interview took at least three hours. The target group was training designers who are actively involved in the design of training for complex domains. The interviews were conducted by two people, one to provide direct eye contact and ask questions and one to record answers and prompt for specific questions if needed. A structured interview instrument guided the interview process to insure that all respondents were asked similar questions. In total 11 interviews were conducted in the following sectors: 1 naval college, 3 air traffic control centres, 2 aircraft maintenance organisations, 1 telecommunications organisation, 1 information technology company, 1 training consultancy organisation and 1 distance education company. Unlike the questionnaires that produced data in one format, the more in-depth interviews were intended to provide detailed and rich information about company design practices. As interviewee background and companies differ substantially, the interviews were loosely structured in the sense that questions were open and no pre-defined answer categories were supplied. This was intended to stimulate the interviewer towards more natural, personal and company-specific responses, and this aspect was a complete success. Nevertheless, some structure was provided for the interviewer by a list of questions and themes to be addressed. Interviewer instructions were also provided since there were multiple interviewing pairs. This was intended to increase the compatibility between the interviews and over the variety of questions asked. The interviews not only yielded more detailed information, but, more importantly, they yielded an impression or feeling of current design practice, which did not emerge from the questionnaires.

The emphases during these data gathering efforts was on the difference between current and ideal training design practice, on the problems experienced during the design process, and on the ideal characteristics of an instructional design tool. In analysing the results, our interest was on the common themes that arose. In general, it can be concluded that current training design practice differs from that what is described in most instructional design models (e.g., Gustafson & Branch, 1997). Activities are carried out selectively and often partly and are characterised by implicit and intuitive methods as suggested by Tennyson (1995). The analysis phase is not carried out explicitly and in detail, mostly due to constraints involving time and resources. The design phase appears often to be combined with the development phase and often happens implicitly as part of the development and implementation of training.

Looking at the background of training designers, most designers have an operational background and are not specifically trained or educated in instructional design or training systems. Specific instructional design models or principles are rarely explicitly used by designers with an operational background. However, many basic ideas and some instructional design principles seem to be intuitively understood and used. These principles are not explicitly or systematically applied to a training plan or design blueprint.

In general, training is not designed in formally structured design teams. The most important actors in a team are subject matter experts and instructors, who typically design the training. Collaborative design does not seem to take place explicitly.

In answering the survey questionnaires and extended interviews, respondents indicated that the most significant and desired characteristics of an ideal instructional design tool are related to:

- targeting actual designers with an operational background;
- using non-academic language;
- providing practical worked-out examples;
- supporting an explicit, structured and systematic design process (especially for the analysis, design and evaluation phases);
- providing guidance in bridging the gap between current and ideal design practice;
- addressing the relational aspect during the training design process (setting up teams, involving users, teamwork, communication, etc.);

- providing support/guidance in applying educational design principles;
- providing methods for file management and version control;
- linking together the different training design products;
- making information easily re-usable and retrievable; and,
- allowing different degrees of freedom (e.g., from structured to non-sequential design).

The interest in structure, reusability, and relevant examples is consistent with the literature search conducted for this project and with the experience of project experts. Some respondents questioned the merit of such a tool as opposed to current design practice; these respondents are most probably the most experienced of those interviewed and are justifiably concerned with regard to the a tool constraining the application of their advanced knowledge and skills. ADAPT^{IT} should therefore be set up in such a way that designers quickly become aware of and are convinced of the additional value of ADAPT^{IT}, while allowing advanced users to integrate their own knowledge and skills. In addition, designers must be able to design training more quickly (increased efficiency) and to design better training (increased effectiveness) with ADAPT^{IT}.

Assessment within ADAPT^{IT}

The project is addressing two additional kinds of assessment issues: (1) validating the tool against the theoretically-based design methodology upon which it is based; and, (2) demonstrating the effectiveness of the tool and the method in terms of learning outcomes. The outcomes of the needs assessment phase described above have led to specific method and tool requirements that are being integrated into the first prototype. Field tryouts with users in real-world settings will then lead to a second iteration and refinement of the method and tool. The project will assess the usability and utility of the refined method and tool by aviation industry practitioners. In addition, the project will content a quality assessment of the design blueprints produced as well as an effectiveness assessment of the training developed according to those design blueprints. As was the case with the Experimental Advanced Instructional Design Advisor effort (Spector, 1995), ADAPT^{IT} intends to improve both efficiency and effectiveness.

Additional requirements for ADAPT^{IT} have not been emphasised in this paper since the focus has been on the assessment methods and their implications. However, it is the intent to include a number of design advisors, customised to the appropriate enterprise setting. In the aviation industry, safety requirements are paramount and these must be emphasised in all training, both for maintenance technicians as well as for air traffic controllers. Moreover, there are aviation industry standards for the portability of training set by the Aviation Industry Computing Consortium (AICC) in addition to the IEEE standards being developed for meta-data in technology-based training. Finally, there are generic instructional design standards established independently by the International Board of Standards for Training, Performance and Instruction (ibstpi - see http://www.ibstpi.org) that ADAPT^{IT} is committed to include. The overall assessment of ADAPT^{IT} will include an external evaluation of how well the method and tool adhere to these various sets of standards.

Conclusions

While there have been efforts in the area of automated support for instructional design (Spector, Polson, & Muraida, 1993), what has been missing in this area are sufficiently elaborated design models with associated guidance and frameworks that are appropriate for the design of training for complex cognitive skills. The ADAPT^{IT} project is intended to fill this gap in the set of methods and tools available to instructional designers. The outcome of the needs assessment phase strongly suggests that the demand for such an integrated method-tool combination is highly desired by business and industry. The user-centred process adopted for this project insure that these real world needs will be addressed in the project and its products. The assessment of European designers described in this paper has resulted in a set of design requirements that will also be used for evaluating the final outcomes of the effort.

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Evaluating Distance Learning: Feedback from "Distressed" Students

Christopher Essex
Kursat Cagiltay
Indiana University

Abstract

This paper presents the results of a student evaluation of a web-based distance education course offered by a major university in the midwestern United States. The findings of this study found that some students experienced what Hara and Kling (2000) call distance education "distress" and that, while they found the course to be a satisfactory educational experience, their online interactions were judged to be less than ideal.

Introduction

Almost all students from elementary to higher education are educated in a lecture based educational system. The communication patterns and characteristics of face-to-face lecture based environments can be quite different from those found in a distance education environment. For example, in a web-based distance education environment, all verbal and non-verbal communication cues, traditionally found in a face-to-face environment, disappear. In this new environment, supportive teacher-student interaction and student-student networking become very important. Although many argue that the web can be a good environment for delivering sound educational experiences, currently there is very little solid research to identify key issues to making online distance education experience a satisfying one for students. We hope that this research's results will contribute to the efforts to close this gap.

Purpose of the Study

This study examined some of the factors that contribute to student satisfaction in web-based distance education courses. In this study, by examining several factors based on Kirkpatrick's Four Levels of Evaluation (Kirkpatrick, 1998), the researchers explored students' responses to the instructor, activities and materials of a fully online, graduate-level course. The researchers compared their findings to those obtained by Hara and Kling (2000), and used their definition of "distress" to discuss students' negative feedback regarding their online course experience.

Statement of Significance

As stated by Keegan (1996), and Reeves in Khan (1997), there is not enough and quality research on several important aspects of web-based distance education. This research effort will attempt to evaluate student satisfaction regarding an online course based on a common structure for measuring student reaction to a course or training effort, Kirkpatrick's Four Levels of Evaluation. It is hoped that this evaluation effort will help other online instructors and course designers in their efforts to design online courses that will be effective and satisfying to their students.

Literature Review

The term "distance education" or "distance learning" refers to the teaching-learning arrangement in which the learner and teacher are separated by location and/or time (Moore, 1990). The World Wide Web (WWW) is a distributed, hypermedia based, platform independent, architecture for sharing information. Web-based education is defined as education delivered in whole or in part using the Web and related technologies (Khan, 1997). There are many other similar terms used to describe web-based education, such as: online courseware, learnware, distance education online, etc.

Through the years, distance education has taken advantage of current technologies, incorporating into the teaching and learning environment telecommunication technologies such as radio and television broadcasting, audio and video recording, live, two-way interactive audio, video. More recently there has been a huge growth in the use of synchronous & asynchronous computer-based interaction tools on the Internet or the World Wide Web (WWW) (Moore & Kearsley 1996). Today, Internet-based distance learning is one of the most rapidly growing aspects of education and training in the world.

While many argue that there is promising future in the use of the Web in education, there is no satisfying answer for the question of how this technology can best be used to approximate, or better, the traditional on-campus classroom experience. As stated by Windschitl (1998) and Moore (1990), much of the published work about distance education has been anecdotal descriptions of activities such as setting up on-line mentoring programs or how to get students involved in collaborative web-based activities with other schools. However there is not much solid research on the evaluation of Internet-based distance education.

Much attention was recently given, including an article in the *New York Times*, to a study by Hara and Kling (2000) that focused on the frustration expressed by to students in an online distance education course, an extreme level of frustration that Hara and Kling refer to as 'distress.' Certainly, the results of this study should concern distance educators and administrators at institutions that offer distance education courses. But as the *New York Times* article stated, "The report looks at just one class -- and a small one at that -- so it is not a survey of distance education courses as a whole, and few if any generalizations can be drawn from it." Further studies looking at the experiences of online distance education students need to be performed before any serious judgments of the pros and cons of this new educational delivery system are made. The present study will, we hope, add to the body of knowledge about how students experience this new type of college course.

Definition of "Distress"

Hara and Kling (2000) defined distance education 'distress' as "situations that the students...find particularly troublesome." They found five main causes of distress for the distance students in the graduate-level online course they evaluated:

- Social Isolation
- Overwhelming Email Communication
- Lack of Instructor Feedback
- Technical Problems
- Ambiguous Instructions

In this study, we will evaluate a similar graduate-level course and see if the students report the same causes of distress.

Research Methods

This study focuses on student evaluations of an online, graduate-level course offered by the School of Education at a large midwestern state university. The class size was not large: 11 students were registered for the course that semester. The instructor for the course under study was a native English speaker, and had previous experience as an online educator, having taught this course and one other course through online means in previous semesters. Students were located in Indiana, Hawaii, Iowa, Tennessee, North Dakota, and Sweden. Because the online course would not have class meetings in a physical location, it was impossible for the researchers to gather data from observation in class and interviews with students. Therefore, the researchers designed web-based questionnaires that would allow us to collect our raw data via the Internet.

The researchers utilized a five-step process for developing these questionnaires:

- Interviewed instructor
- Reviewed course content/activities
- Developed questions based on Kirkpatrick's Four Levels of Evaluation
- Developed online survey instruments
- Integrated surveys into course website

In order to ensure a high percentage of student response, the researchers arranged with the instructor so that the students would have to complete the forms before they went on to the next activity. If students had asked not to fill out the form, the researchers would have allowed them to access the next unit without submitting the form, but none of the students pursued this option. In this way, the researchers were able to get response to our forms from all the students that were actively working on the course requirements. Two students were unable to complete the evaluation: one dropped the course, and one was ill.

The questions on the survey instruments, as noted above, were based on Kirkpatrick's Four Levels of Evaluation (Kirkpatrick, 1998). Each of the levels focused on a different aspect of student response to the course. Our definitions of the four levels are as follows:

- *Level 1 (Student satisfaction):* Student satisfaction towards instructor, methods and content
- Course materials
- Course activities

- Instructor performance
- Overall rating for course
- *Level 2 (Student learning):* Students' gain in knowledge and skills
- *Level 3 (Transfer of learning):* Students' application of knowledge and skills to real job/school environment
- *Level 4 (Cost/benefit impact):* Analysis of efficiency and effectiveness of the program from both the school's and students' point of view

It is important to note that for all of these levels, we were only able to measure the students' estimation of the degree to which the course satisfied their requirements for each level. In particular, for Level 3 (Transfer of Learning), we could only measure the students' opinions regarding whether or not they would be able to transfer their learning to other settings; we were not able to actually measure whether or not this transfer occurred, or would occur.

Results Of The Study

In this section of the paper, we present the results of the student course evaluation. The following paragraphs describe the most significant findings of our study. Overall, the student responses can be summarized as follows, broken down into positive and negative feedback:

Positive Student Feedback

Level 1:

Overall, students gave positive comments regarding this course.

Level 2:

The students reported a moderate level of learning.

Level 3:

Students expected professional benefits in the future from taking the course.

Level 4:

Students responded that the course cost them more money than on-campus course, but saved them time. The majority of the students felt that the cost/benefit ratio of the course was very favorable.

Overall, student reaction to the course was positive. In their evaluations, they provided us with some positive comments about the course. Most students were very confident that they had accomplished the learning objectives of the course. Students expected professional benefits in the future from taking the course. The majority of the students commented that the course saved them the time and effort of coming to campus to take a course in the traditional manner.

Negative Feedback: 'Distress'

Level 1:

Many students were not very satisfied with their interactions with the instructor.

Level 2:

A small number of students were not well prepared for the technological requirements of this course, which caused them frustration.

Level 4:

Students responded the course cost them more money than an on-campus course. Also, some students cited decreased time to spend with their family and on their work as an opportunity cost of the course. One student stated, "I have little time for my family. (...) Much time is spent with the mechanics of the course, which includes posting on work on websites and submitting it." Another student said, "I have been forced to reduce some of my time at work."

Levels 1, 2, 3:

One student, in a moment of "distress," made the following statement: "I am totally frustrated. I absolutely do not know how this class is organized and how to access the information I need. I hate Long Distance education and I never plan to do this ever again. It has made me rethink even using the Internet in my class at school. I hate this. I hate this. I hate this."

In their findings, Hara and Kling noted two primary sources of students' 'distress': technological problems, and the instructor's online communication practices. Our study found the same issues were the primary concerns of the students in this course.

The course required students to navigate through various websites, send and respond to email messages, and use a web-based conferencing tool for class discussion purposes. Some students reported difficulties with utilizing the technologies required for these tasks. A few students complained about the way the course website, which was developed by the instructor, was structured.

In this course, many students were not very satisfied with their online interactions with the instructor. While the students recognized the instructor's knowledge of the subject matter, the majority of the students (5 of 9 respondents) did not give positive evaluations of their online interactions with the instructor.

In comparing our findings with those of Hara and Kling, our students reported that they shared 3 of 5 causes of 'distress' with the students in the Hara and Kling study.

- Social Isolation (not found)
- Overwhelming Email Communication (not found)
- Lack of Instructor Feedback (found)
- Technical Problems (found)
- Ambiguous Instructions (found)

Thus, the majority of the causes of 'distress' were the same for both courses.

Recommendations

After a careful review of the student responses to the course evaluation instruments, and our analysis of the causes of distance education student 'distress,' we have developed the following recommendations for online course instructors.

- The instructor should review her practices in responding to students' email and web-based conferencing posts, to ensure that she is providing sufficient and appropriate feedback.
- The instructor should specify the technological requirements in the syllabus, and arrange for technical support.
- The instructor should conduct a usability tests on the course requirements and other instructions to ensure that they are clear and non-ambiguous.
- Even though the students did not report that social isolation was a major factor causing 'distress', we recommend that, due to its prevalence in the Hara and Kling study, the distance education program should provide an on-campus face-to-face orientation for its distance students. For students that cannot be on-campus, a videotape should be provided.

Limitations

The research design for this study faced a number of limitations, chief among them being a limited time frame for administering the evaluation. Other limitations were:

- Small sample size (though entire class)
- Education students may be atypical
- Lack of follow-up evaluation
- Lack of ability to measure Level 3 (Transfer of Learning)

Conclusions

Of course, as with Hara and Kling's study, the generalizability of the data in this survey is necessarily limited because it is only based on the student evaluations of one course. But as more online courses are delivered, and more students have the opportunity to voice their opinions on the pedagogy and technology of these courses, the researchers feel that it is important that their responses are shared with distance education instructors and administrators of online programs.

Based on the experiences of the students in this online course, the researchers have two primary recommendations for others developing such courses.

First, to ensure that the students feel "The Pains of Innovation" as Hara and Kling refer to it, to the least degree possible, the instructor should clearly specify the technological requirements at the outset of the course and should supply, or arrange for others to supply, the necessary technical support.

Second, more attention also needs to be paid to developing and refining methods of moderating and monitoring online discussions with students. The researchers suggest that instructors should review their practices

regarding responding to students' email and web-based conferencing posts, so ensure that they are providing sufficient, appropriate, and reasonably prompt feedback.

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Win-win: Students Using Instructional Design Skills to Teach Faculty to Integrate Technology in Teacher Education

Catherine P. Fulford
Ariana Eichelberger
University of Hawaii at Manoa

Abstract

A win-win partnership has been created in the University of Hawaii Educational Technology Master's program allowing graduate students to try out their new skills by teaching faculty to integrate technology. These efforts have been in concert with USDOE Preparing Tomorrow's Teachers for Technology [PT3] and Eisenhower grant projects designed to provide professional development for a new designation of "technology intensive" courses. Workshops and individual assistance are provided by graduate students in practicum and internship courses.

Students in instructional design and technology programs learn valuable skills that can be transferred to the real world of work. However, this transfer may be less than successful if appropriate guided opportunities are not provided to bridge the gap from school to work. A win-win situation has been created in the University of Hawaii's Educational Technology (ETEC) master's program that allows graduate students to try out their new skills by teaching College of Education (COE) faculty to integrate technology into their courses.

After completing core courses in educational technology including one year of instructional design, students are required to take an Educational Technology Practicum. The practicum provides students a guided setting for trying out their new skills in a real-world experience. This model may be typical of many programs, but what is unusual is the partnership that has been formed by graduate students and faculty to provide a valuable service for the College of Education. In this course, students work as a group to design technology workshops.

These efforts have been in concert with the US Department of Education's "Preparing Tomorrow's Teachers to Use Technology" and Eisenhower Professional Development Fund grant projects in the Educational Technology department, These projects have been designed to provide professional development for a new designation of "technology intensive" (TI) courses.

Each year the graduate students in the Educational Technology Practicum have unanimously chosen to continue conducting technology workshops to hone their instructional design skills and provide the service to the COE faculty. To maximize involvement, the practicum course enrollment is purposefully kept small, ranging from five to ten students.

Students in the course are ETEC majors who have completed their first year. Required in the first year are courses in which students usc a variety of media to analyze systems, conduct needs assessments, explore change theories, create instructional hierarchies and write formal instruction. Practicum students come from a variety of backgrounds. As most Educational Technology courses are taught in the evenings, many students have full time jobs or are practicing teachers. The varying experiences they have outside of the department bring numerous viewpoints and skills to the group.

Students are allowed as much leeway as possible in determining and carrying out their design plan. The only requirements are that they follow standard design procedures. Educational Technology students in the first year use Dick and Carey's (1996) systems approach for designing instruction. The practicum gives students the opportunity to directly apply this approach to the real experience of designing and conducting workshops.

The first step of the Dick and Carey model is assessing need and identifying goals. In order for the practicum to be win-win, students identify their own needs and goals as well as those of the faculty. Initial class discussions are ones in which students identify their WIIFMs or "what's in it for me?" They discuss what they would like to learn and ultimately like to get out of the course. Students also identify skills they have in the group especially with regard to technology knowledge that can be shared with the faculty.

The win-win situation is fostered by the students considering their own needs concurrently with those of the faculty. Needs analysis studies of the faculty have been conducted frequently in the College of Education to find out how technology is being used, identify the training needs of faculty, and provide recommendations for the future growth of technology applications in the COE. The most recent study was conducted in 1999 by Ho, Sherry, Speitel, & Walton.

Responses from the faculty regarding what technologies they feel are relevant and interesting become a valuable guide for the students. Students now match what they would like to teach and learn with what the faculty want to learn. From this teaming emerge the student goals for themselves, the practicum and for teaching the faculty.

Instrumental in this planning phase are Dick and Carey's second and third steps, analyzing content and audience. Students must consider the faculty and themselves as the audience in order for the situation to remain win-win. This is when they begin to reconcile what the faculty want to gain and what they themselves want to gain from this experience. Resources are an important factor when determining content. Questions asked at this point are: What equipment do we have available to us in the department? What equipment do faculty have available to them in their departments? Who within the group has the skills to teach what the faculty want to learn? Where can we locate resources and expertise outside of our group? With these questions answered, a series of topics for the workshops are conceived and scheduled across the semester. An average of 5 workshops are scheduled over each practicum semester giving students initial planning time and a week between each workshop event.

Workshop topics covered in the Fall 2000 semester include: Online collaboration supported by WebCT, Electronic portfolios, Inspiration, the mind mapping software, Dreamweaver for web authoring, Adobe Acrobat, and preventative computer maintenance, among others. The Fall 2000 group also organized an open house event for the COE's Technology Learning Center. Past groups have conducted mini-conferences featuring break-out sessions with faculty members who technology intensive courses.

Students must now recruit for and advertise the workshops. Email messages, fliers in faculty boxes and word of mouth are the most common methods of advertising. Registration rates provide the students with informal data on what the faculty are truly interested in. Barring scheduling conflicts and other commitments, students assume that workshops with high registration rates are covering topics more relevant and interesting to faculty than those which are not being registered for. Well designed registration forms will also collect additional information about participants' skill levels, position and interests.

The fourth step of the Dick and Carey model, writing objectives, is now completed. The COE needs assessments in which faculty have rated their confidence and skill levels with specific technologies prove again to be a valuable resource. Based on the skill levels reported by faculty and the topics that have been decided upon, objectives are written for each workshop. Students must also take into account how much content can reasonably be covered in the two-hour workshop time period. An example of an objective from a Microsoft Word workshop is "participants will be able to save a Microsoft Word text file in HTML format." A Photoshop workshop example is "participants will be able to import layers from other files."

Students now take Dick and Carey's fifth step and develop their test or evaluation tools. Evaluations are directly aligned with the objectives for each workshop and are administered at the end of each workshop. Surveys are the most common instrument used and look primarily for changes in the affective domain. Faculty report on their confidence levels with technology before and after the workshop, rank the personal relevance of the information presented and comment on their interest in the topics and guest speakers. Questions are directly aligned to the content presented in each workshop. It is important to note that students are encouraged to make the evaluation instruments non-threatening to faculty and to avoid making faculty members feel they are being tested. Students are also encouraged not to solicit information which may be perceived as judging the quest speakers. Appropriate space is allotted for suggestions and comments from the faculty on how to improve and revise further workshops.

Dick and Carey's model now calls upon the students to develop a strategy. Students are reminded to review Smith and Ragan's (1993) organizational, delivery and management components of instructional strategies. Organizational aspects encompass the scope and extent of content. Content is made specific and thought given to how thoroughly it can be covered in the workshop time period. Delivery components include issues of appropriate media selection and workshop style. Appropriate media compliment and enhance workshop topics. Depending on content, one or more of the following delivery styles is chosen: student presentations, guest speakers, hands-on activities, discussions, and use of examples or non-examples. Student presentation of content most often involves multimedia presentation software such as PowerPoint. Content is usually demonstrated step by step while the faculty observe or follow along with paper-based materials.

Guest speakers are a popular way for students to provide faculty with examples of real classroom applications for the technologies presented. Guest speakers are chosen for their motivational style and positive attitudes as well as their personal and innovative methods of technology integration. The goal of having a guest speaker is to motivate and stimulate the faculty to generate ideas about technology integration in their own classrooms.

A common workshop agenda begins with a guest speaker followed by student presentation of content using multimedia presentation software. This portion of the workshop tends occur in a classroom-style setting. Following a short break, the workshop moves to the teaching lab where participants can work individually or in pairs on computers to practice the technology applications. This type of workshop has proven to be a successful blend of the technology integration issues the ETEC department students and faculty want to teach and the hardware and software specifics the COE faculty want to learn.

Hands-on activities are popular for most workshops. The COE has two teaching labs, one Macintosh and one IBM compatible in which hands-on activities can be conducted. Each room has approximately 20 computers. Hands-on activities provide participants with the opportunity to practice their new technology skills while the practicum students act as helpers. When faculty have been provided opportunities to attend workshops solely regarding integration, response has been lower than when integration issues are paired with hands-on activities in which they learn hardware and software specifics. Participants have reported that hands-on activities increase their confidence levels with technology and are more exciting than presentations alone. The practicum situation, with 5 to 10 students available, presents the opportunity to provide one-on-one assistance during the instruction.

Discussions are considered for a workshop when content may relate to but not be specifically based on technology skills. For example, a discussion about technology standards and their application in the classroom might be more appropriate than a hands-on activity about the same topic.

Students may also employ the use of examples and non-examples to demonstrate effective applications of the content they present. While guest speakers provide examples of a positive technology applications, students may also consider the use of non-examples or negative applications of technology. Non-examples present a negative usage of a technology with the intent of reinforcing the validity of positive usages.

In conjunction with determining what types of media, materials, speakers, and format should be used, students must also address the management and practicalities of facilitating the events. Good management strategies become imperative at this time. Tasks include but are in no way limited to locating and reserving facilities and equipment and soliciting and confirming guest speakers. Students now decide not only how the workshops will be managed but how they will manage themselves as a group to achieve the goals they have set for themselves. They create extensive task lists and checklists then assign roles to members of the group. Different groups organize themselves differently. Some groups have found it beneficial for all group members to work on and contribute to each workshop while some groups assign individuals as leaders of particular workshops with the rest of the group acting as support to that leader. The assignments of these roles tend to have long term impact on the success of the practicum. Although students are encouraged to and do revise throughout the course these initially assigned roles tend to remain consistent throughout the semester. The most success has occurred when roles are assigned which align with an individual's strengths as well as their WIIFMs. For example, a student that would like management experience often becomes an overall leader of the group. A student with extreme stage fright and a desire for better presentation skills may not be the most appropriate person to be the main presenter for workshops. On the other hand, the instructor may encourage this person to be a presenter at least once to provide a learning experience and opportunity to develop those skills.

Following the progression of the Dick and Carey model students then develop materials for the workshops. Bearing in mind the delivery style and content of the workshops, accompanying materials are created ranging from web to paper-based instructional booklets. Multimedia presentations are most often used to present content and demonstrate software applications. The design of materials incorporates a variety of instructional styles. Some workshops may use instructional materials during hands-on activities while participants follow along step by step. Other materials are designed to be used after the workshop. An example of an after-workshop resource is instruction on advanced features of a technology which were not addressed in the workshop. Other after-workshop resources have included workshop series web sites with general information, workshop schedules and PDF files of workshop materials. Fall 1999 semester's web address is http://www2.hawaii.edu/~ganne/PauHana. Students are encouraged to be "resource linkers" when developing materials, locating available existing resources and materials and incorporating them into their own.

The production of materials brings up issues of theme and appearance. This issue most often reflects the management style of the group. Groups who are extremely collaborative with all group members working on all workshops tend to devise on an overall theme and look for the workshop series and accompanying materials while groups in which leaders emerge for specific workshops may develop different looks for different workshops. Accompanying materials have included advertising fliers, registration forms, evaluation surveys, instructional booklets, web sites, agendas and certificates of acknowledgement given to guest speakers.

Dick and Carey's model stresses that formative evaluation and revisions take place throughout the design process. When the practicum workshops have been developed, formative evaluation is conducted through

rehearsals. A "dry-run" of each workshop is one of the few requirements of the course. The opportunity to go through all materials and instruction in real time and in the actual setting provides students with practice that improves their presentations and workshops dramatically. The group and the instructor observe and participate in the workshop rehearsals. Following rehearsal, presenters critique themselves on aspects they felt were problematic and the rest of the group is encouraged to provide additional opinions. They catch many mistakes and timing misjudgments. Lastly, the instructor provides feedback and suggestions. Rehearsal sessions take place one week before workshop events and students make final revisions throughout the week.

The course period is 2.5 hours long and workshop sessions are 2 hours. The extra half hour is used for set-up prior to and breakdown after the event. Details overseen by students for workshop events include registration tables, pre-printed nametags for participants, sign in sheets and refreshments. Students dress more formally for workshops than they do for class. Workshop participants are asked to complete evaluation forms at the end of each workshop. Students provide "prizes" such as candy for those who complete evaluation forms to raise the turn-in rate. Following each workshop the instructor and the practicum group conduct another formative evaluation session, or "de-briefing". They discuss what went right and what went wrong. Participant evaluations are reviewed and discussed. Students reflect on the process of planning and conducting the workshop and suggestions are offered as to what will make the next workshops better.

The last stage of the practicum course and the Dick and Carey model concentrates on summative evaluation. Students are required to produce a final report about the course. In it they include the objectives for each workshop, their WIIFMs or "what's in it for me" statements, what went wrong and what went right in each workshop, their reflections and suggestions for future workshops and all the original materials they created in the course. This document is addressed to the next practicum group as advice from those who just went through the process. Examples of what went right and wrong statements for an Avid cinema workshop include: "I'm glad I created a personal timeline to help me get all my tasks done, especially for the day before the event. I'm also glad I used templates in the workshop that faculty could use. I should have tested the hands-on part on the workshop day. I should have practiced more to make my timing smooth". Reflections about the course include statements such as: "Listening to team feedback is important, I learned to ask for help from the team, and I learned the importance of preplanning". Examples of suggestions for the future include: revise, revise, revise, plan ahead, delegate small tasks out to the whole team, and rehearse, rehearse, rehearse. Some practicum groups have created fliers with "10 tips" for the next group offering advice and suggestions of how to get started and what to avoid in the planning and execution phases of the workshops.

Over the four years the course has conducted faculty workshops, student evaluations have been consistently high and the course is always full. Faculty in the department who employ students who have been through the course report that these students tend to have excellent presentation skills and high levels of confidence. Workshop sessions are consitently well attended and evaluations positive. In this way the process is win-win. Students get a real world design and presentation experience and the faculty get free, in-house technology workshops tailored specifically to their needs.

Following the practicum workshops, faculty are recruited to be involved with grant projects and redesign their courses to be technology intensive. The grants provide student technology consultants who meet weekly with the faculty members for one-on-one mentoring to help them achieve this goal. The National Council on Accreditation of Teacher Education (1999) suggests that mentoring and providing feedback is an effective method of professional development in technology integration.

The student consultants, who are primarily students in the Educational Technology masters program, again, have an opportunity to use instructional design skills in their approach to faculty mentoring. As consultants they: (a) conduct individual needs assessments of faculty members, (b) set goals for the professional development; (c) provide expertise in creating a revised curriculum; (d) assist in improving technical skills to help faulty members reach their technology integration goals; and (e) provide encouragement and guidance in course design and technology integration. The goal and final product of the mentoring is a technology intensive course proposal in which the faculty member outlines how they have restructured one or more of their courses using the technology intensive standards. These standards directly parallel the International Society for Technology in Education (ISTE) standards and were developed through a grant project at the University of Hawaii in 1996. The essence of a TI course is that both the instructor and student are actively using technology in the teaching and learning process. An example of a redesigned TI course would be one in which students and instructor are communicating via email, the instructor is using multimedia software to present content in class and students are giving multimedia presentations in place of papers. Redesigned courses also often include the inclusion of web based activities such as electronic bulletin boards, chat rooms, threaded discussions and web site construction, or digital video and electronic portfolios.

Based on grant project evaluations and course evaluations, students and faculty have greatly increased their skill levels and their confidence with technology and its integration in the classroom. This partnership has created a synergistic effect that is best described by Covey (1994). "Win-win means that agreements or solutions are mutually beneficial, mutually satisfying. With a win-win solution, all parties feel good about the decision and feel committed to the action plan."(p.117) The evaluations by both faculty and students have confirmed that their partnership meets this ultimate goal.

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A Comparison of Collaborative Learning and Audience Awareness in Two Computer-Mediated Writing Environments

Barbara Gaddis
Harriet Napierkowski
Nadyne Guzman
University of Colorado at Colorado Springs

Rodney Muth
University of Colorado at Denver

Abstract

In this study, we examined differences between two populations of composition students over the course of a semester in their perceptions of collaboration as reported in pre- and post-surveys. In addition, using an assessment rubric we developed, we examined students' audience awareness as demonstrated in their writing. Both groups of students were taught by the same instructor and had the same writing assignments; both classes incorporated a pedagogy of collaborative learning to help students develop a sense of belonging to a discourse community; and both sections used networked computers as learning, writing, and communication tools. The distinguishing variable between the two sections was the absence of face-to-face communication among students in the online class. In our study, we posed the following research questions: In a comparison of students in a on-campus networked writing class with students in an off-campus online writing class, (a) Do students differ in how they value collaboration during the writing process? (b) Do students differ in how they address audience needs in their writing products? (c) Do students differ in their level of satisfaction with their learning experience? Conclusions from this study are the following: (1) Online students tend to be more independent learners, valuing collaboration less than do on-campus students; (2) Online interaction appears to increase audience awareness in students' writing. (3) Students in both sections reported positive experiences with their respective classes.

The field of composition has undergone two significant paradigm shifts in the last twenty years: from a focus on the product of writing to a focus on the process, and from a focus on the writer as a solitary individual to a focus on the writer as part of a discourse community, "a group of people with similar goals and interests who constitute themselves with a characteristic language" (Bruffee, 1993, p. 223). A more recent development, the use of computer-mediated instruction in the college composition classroom, has facilitated both paradigm shifts.

At the University of Colorado at Colorado Springs (UCCS), for example, all writing classes are taught in networked-computer classrooms, where students interact both through face-to-face and through computer-mediated communication. In this environment, students have increased opportunities to engage in the writing process through collaborative partnerships with other students. The networked computers become conduits for linking students with one another, thereby extending the discourse community in the classroom through a second framework via cyberspace: shared virtual "chambers" where continued interaction takes place and where a repository of student work, both individually and collaboratively produced, resides as a catalyst for further dialectic.

At the same time, universities are experimenting with the delivery of writing courses exclusively via distance learning, without face-to-face interaction. In the fall 1999 semester, UCCS joined the ranks of these universities by delivering one section of freshman composition as an online course.

Computer-Mediated Communication

Computer-mediated communication (CMC) changes both the quality and quantity of communication by allowing time for critical reflection and greater involvement in discussion than is allowed in the traditional classroom, where one or two students may monopolize the conversation (Berge, 1995; Fishman, 1997; Wells, 1992). Group conferencing appears to decrease the emergence of a group leader, allowing more students a greater role (Harasim, 1990; Warschauer, 1997). Student-directed conversation and participation level is higher in the CMC classroom, which shifts the role of the teacher from content expert to facilitative guide (Wells, 1992). CMC thus enhances peer-to-peer discussion (Jonassen et al., 1995), and participation is fairly evenly distributed among students. Students report that they work harder and produce higher quality work, since work is visible to their peers (Oblinger & Maruyama, 1996). In addition, computer conferencing tools foster critical thinking and active learning

by providing an electronic space for reflective journal writing, critical analysis, and peer and instructor facilitation (Bonk & Reynolds, 1997). Instructors are able to observe students' contributions to discussion, obtain a record of the discussion for future feedback, participate in the discussion to model critical-thinking skills, and ask questions to coach critical thinking, providing expertise when necessary (Wagner & McCombs, 1995).

Collaboration

Collaboration enhances connectivity and socio-emotional commitment to the learning process by involving students as active participants in the learning process (Sharan, 1980; Oliver & Reeves, 1994). Students achieve greater cognitive development working together than they do working individually (Sharan; Oliver & Reeves). Collaboration can contribute to the active construction of meaning, through idea generating (divergent thinking), idea linking (convergent thinking), and idea structuring (categorization and classification) (Harasim, 1990). Online collaboration, with its emphasis on both reflection and interaction, can amplify the process of knowledge construction (Warschauer, 1997). Collaborative problem solving, involving both conversation and issue-based discussion, supports intentional learning and develops critical-thinking skills (Duffy, Dueber, & Hawley, 1998). Web-based tools such as e-mail, electronic partnerships, project-based learning, and synchronous or asynchronous conferencing foster collaborative learning (Bonk & Reynolds, 1997).

Advantages and Limitations of Asynchronous Collaboration

While the effectiveness of these collaborative tools has not been extensively studied, asynchronous communication and online collaboration have some recognizable strengths and weaknesses. Strengths of computer-mediated collaboration include student enthusiasm, more time on task, and student satisfaction (Shotsberger, 1996; Kerner, Penner-Hahn, Berger, & Dershimer, 1997). Students appear to like CMC, find the instructor is more accessible, and find problem-based learning and case-study learning more useful than they are in a traditional classroom. Disadvantages include communication anxiety, feelings of disconnectedness from conversational thread, and frustration over delayed feedback. Additionally, making decisions from group consensus can be time-consuming (Harasim, 1990; Warschauer, 1997), while software and hardware problems may limit interaction (Oliver & Reeves, 1994). One of the biggest drawbacks to asynchronous collaboration is the lack of visual and verbal cues provided by face-to-face interaction. (Lehman, 1995).

Online Students vs. Traditional Students

A comparison of online and traditional students shows that online students learn on average as well as traditional students, with respect to midterms, finals and grades. More mature and better students learn more, while students who lack good study habits and have difficulty writing and reading learn less (Harasim, 1990). Self-discipline is a crucial element of success in online learning. Hiltz (1990) examined learning in online and traditional classes using pre-/post-questionnaires, case studies, institutional data, interviews with students and faculty, and survey of dropouts. She found no significant difference between mastery in the online class and traditional classrooms. In fact, the grades for students in the online computer science class were better than the grades for traditional students. She concludes that online students learn as well as traditional students. Simonson, Schlosser, and Anderson (1994) concur: Students who are motivated, prepared, and intelligent can potentially learn as much online as in a traditional classroom. While attrition rates are generally higher for online students, researchers have found little correlation between performance outcomes and individual characteristics, especially for mature learners (Kember, 1990).

Collaborative Learning, Writing, and Audience Awareness

Collaborative learning in higher education has been underused and frequently misunderstood. Bruffee (1993) posits that knowledge is a social construct, that learning is a social process, and that writing is central—not ancillary—to collaborative learning and the construction of knowledge. In addition, Oakeshott (1962), Sergiovanni, (1996), Latour and Woolgar (1986) all emphasize the importance of social dialectic in the construction of knowledge. The use of technology in the teaching of writing has also been widely discussed (Hawisher, LeBlanc, Moran, & Selfe, 1996). However, although researchers have documented a variety of benefits from the integration of technology in the composition class (Carbone, 1993; Klem & Moran, 1992; Mason, Duin, & Lammers, 1994), the data about writing improvement are less clear.

Current approaches to audience include historical studies (Willard & Brown, 1990; Willey, 1990), studies of writers' audience awareness during the writing process (Moffett, 1968), studies of audience as a discourse community (Enos, 1990; Rafoth, 1990; Roth, 1990; Mangelsdorf, Roen, & Taylor, 1990), and links between audience awareness and syntactic and lexical features (Rubin & O'Looney, 1990). This interest in audience is related

to the increased focus on examining composition from a social constructivist perspective (Bruffee, 1986). In addition, an ongoing debate centers on whether writers "invoke" a fictionalized audience or "address" an actual audience. Scholars agree, however, that actual readers can have a powerful effect on writers (Long, 1990; Ede & Lunsford, 1984; Porter, 1992).

Research Design and Methodology

In this study, we examined differences between two populations of composition students over the course of a semester in their perceptions of collaboration as reported in pre- and post-surveys. In addition, using an assessment rubric we developed, we examined students' audience awareness as demonstrated in their writing. Both groups of students were taught by the same instructor and had the same writing assignments; both classes incorporated a pedagogy of collaborative learning to help students develop a sense of belonging to a discourse community; and both sections used networked computers as learning, writing, and communication tools. The distinguishing variable between the two sections was the absence of face-to-face communication among students in the online class. In our study, we posed the following research questions: In a comparison of students in a on-campus networked writing class with students in an off-campus online writing class, (a) Do students differ in how they value collaboration during the writing process? (b) Do students differ in how they address audience needs in their writing products? (c) Do students differ in their levcl of satisfaction with their learning experience?

Our rationale for focusing on audience awareness was quite simple: One of the hallmarks of critical thinking and thus of good academic writing is the ability to examine an issue from various perspectives, to take into account opposing views, to be aware that one is writing not for oneself but for an audience of readers who have multiple perspectives and oftcn considerable skepticism toward the writer's perspective. The best way to increase one's credibility with a skeptical audience is to acknowledge readers' likely questions, concerns, and objections and to address them, summarizing opposing views fairly, and responding to those views either through concession or carefully crafted rebuttal (Rogers, 1961). Fundamentally, the writer's obligation is not to create barriers between herself and the reader but rather to build bridges—to find common ground. As beginning writers, first-year college students have difficulty doing this, largely because they are locked in their personal perspectives, often viewing the world in a dualistic, "right and wrong," lens (Perry, 1970; Perry, 1985). Collaboration during the writing process helps students expand their awareness of audience and thus, presumably, helps them improve this important aspect of their writing.

Objectives of the freshman composition are to improve students' research and argumentative writing skills and to help students gain confidence in their writing ability. Peer response sessions on papers-in-progress were an important course component, promoting collaborative learning and heightened audience awareness. To promote collaborative learning in both the on-campus and the online sections, students used FirstClass software, a communication and conferencing package that facilitates students' ability to collaborate with peers and to engage in the various stages of the writing process. For the on-campus students, the computer classroom was equipped with 24 networked PC workstations arranged around the perimeter of the classroom, along with an instructor workstation connected to a video display projector. Students in the on-campus section (N = 18) met twice a week in the networked classroom. Students in the online section (N = 15), on the other hand, with the exception of an initial and final on-campus meeting, completed all their interactions with peers and the instructor online.

But whether students were enrolled in the on-campus or the online class, they were able to access their virtual classroom space, including assignments and work-in-progress by students in the class, both from home computers and from computers in open labs on campus. In both classes, the instructor gave the students a brief introduction and a written instructional guide to the technology itself. Additionally, since this was a second-semester course, most of the students had had previous exposure to FirstClass in their first semester of composition and were thus familiar with the software from the start of the semester.

To determine demographic differences between the students in the on-campus and the online class, we compiled profiles of students in the two sections from survey questions (age, gender, GPA, grade level, work load, family status, technical expertise, and experience) and from the University Student Information System (SIS). Significance in this study was set at $p = .05$.

Procedure for Measuring Students' Attitudes toward Collaboration

Besides providing demographic information, students in both sections completed pre- and post-surveys (Fowler, 1993; Ehrmann & Zuniga, 1997) regarding their attitudes toward collaboration, responding to questions on a 6-point Likert-type scale. To increase face validity of these items, we distributed the instrument to twelve experienced composition faculty in the UCCS English Department Writing Program who reviewed the items and made suggestions.

Procedure for Measuring Students' Performance in Audience Awareness

To determine differences in demonstrated level of audience awareness, the first and final papers—out-of-class, research-based argumentative papers—were collected from all students in both sections. For control purposes, students were given the same assignments for the first and final papers. We wanted students to write on two topics at a similar level of "strength of opinion." To determine this, we polled the students in the pre-survey, asking them to rank six topics on a scale of one to five, "one" representing indifference to a topic, and "five" representing a strongly held position on a topic. The two topics with the most similar means were gun control and capital punishment. Not only were the means similar (gun control topic $\underline{X} = 3.6429$, 1-5 scale; capital punishment $\underline{X} = 3.6667$, 1-5 scale), but students also had relatively strong positions on these issues, so we reasoned that these two topics would require similar levels of cognitive challenge for students in addressing an opposing audience. The first paper assignment instructed students to take and support a position on the issue of gun control, while the final paper assignment instructed them to take and support a position on the issue of the death penalty. In both cases, students were instructed to address an audience that disagreed with the position they took on the issue. The writer's purpose was to gain the readers' respect, if not their assent, for the position argued.

The papers were coded using a random numerical coding system and were assessed by three experienced readers who first completed a "norming" of six of the papers, randomly selected (Elbow, 1996). The readers assessed the papers based on a nine-item rubric, using a primary-trait six-point criterion-referenced scale (Walvoord & Anderson, 1998) that we developed. The nine items include six elements of audience awareness important in argumentative writing, the genre focus of English 141: purpose, empirical support, logical appeal, ethical appeal, emotional appeal, and treatment of opposing views. These are based on Aristotle's logos, ethos, and pathos, on Toulmin's (1958) model of informal reasoning, and on Rogerian rhetoric (Rogers, 1961). We also examined three additional elements considered standard in essay assessment: organization, syntax, and grammar. Trimble (2000) argues that these additional elements do in fact fall under the rubric of audience awareness, and that writing for an audience is less effective in the absence of control in these areas. Inter-rater reliability scores for the rubric elements ranged from 0.66 to 0.89.

Results and Discussion

The online class was significantly older ($\underline{M}$ =28.36 years) than the on-campus class ($\underline{M} = 20.5$, $\underline{F} = 13.167$, $\underline{p} < .01$), and a significantly higher portion of the online students were married ($\underline{p} < .01$). Although age was correlated with other demographic variables, such as the number of dependents, employment hours, and credit hours, these other variables were not significantly different between the two sections.

Online students and on-campus students did not differ significantly in academic background. Students had comparable grade point averages, TSWE scores, SAT-English scores, ACT-English scores, and grades in English 131, the prerequisite composition course for English 141. Students in both sections were similarly comfortable with computer technology, Internet access, and CyberClass usage. However, several interesting motivational differences between the sample populations were evident. Online students ranked themselves higher on self-discipline than did on-campus students, but they planned to devote fewer hours studying for the class. This difference is significant, even when age was used as a covariate ($\underline{F} = 6.473$, $\underline{p} < .01$). In addition, online and on-campus students had different motivations for taking the class that they selected. Online students cited convenience, while on-campus students cited the good time block as being the primary reason for choosing the particular section.

Collaboration Survey Results

At the beginning of the semester, students in both sections held similar views of collaboration, with no significant difference in overall collaboration scores between the two sections. However, online students' collaboration scores were significantly lower at the end of the semester than they had been at the beginning, suggesting a decrease in their valuing of collaboration as the semester progressed. This finding is in contrast to the literature that suggests that elcctronic communication enhances a sense of community (Harasim, 1990). In our study, online students valued community less, believed less strongly that knowing other students in the class improved learning, and exhibited less preference for face-to-face communication over written communication.

Factor analysis of thc 25 collaboration survey items resulted in two factors, accounting for 42.589% of the variance. The reliability for this instrument was a = .8910. Factor one ("valuing peer feedback on work in progress") contained twelve items, while factor two ("sense of belonging to a discourse community") comprised four survey items. Using ANOVA, we found no significant differences on either the pre- or the post-survey for factor one: Whether they were enrolled in the online or the on-campus section, no significant differences emerged in how students valued peer feedback on work in progress either on the pre-survey or the post-survey. We also calculated

the difference between sections in the amount of change in attitudes in factor one. While the scores for the online students went down over the course of the semester ($M = -2.33$) and the scores for the on-campus students went up ($M = .357$), the difference between groups in the amount of change was not significant ($F = 1.21$, $p < .282$).

Analysis of responses towards factor two items indicates that feeling connected was significantly less important to the learning experience for online students than it was for on-campus students. While the scores for the online students went down over the course of the semester ($M = -1.38$) and the scores for the on-campus students went up ($M = 2.00$), the difference in the amount of change was not significant ($F = 2.451$, $p < .130$).

Audience Awareness Rubric Results

In examining the survey results, we were primarily interested in students' attitudes and self-perceptions. In examining students' final papers, we shifted our gaze from attitudes to actual writing performance, focusing particularly on students' demonstrated audience awareness. We wanted to see if any differences emerged in students' writing depending on whether students collaborated on their papers in a face-to-face environment or exclusively online.

We compared scores on the nine elements of the audience awareness rubric, on both the first and the final papers. In spite of the lack of face-to-face collaboration, online students scored significantly higher on eight of the rubric elements on the first paper and on all nine of the elements on the final paper, as can be seen in Table 1:

Table 1

<u>Comparison of Means in Audience Awareness Between Sections</u>

	First Paper <u>M</u>			Final Paper <u>M</u>		
Rubric Element	Online	Campus	<u>M</u> Dif	Online	Campus	<u>M</u> Dif
1. Purpose	13.07	10.56	2.51*	13.60	10.67	2.93**
2. Empirical evidence	13.20	10.44	2.76*	14.33	10.89	3.44**
3. Logical appeal	12.73	10.33	2.40*	14.67	10.11	4.56**
4. Ethical appeal	12.53	10.22	2.31*	14.47	10.56	3.91**
5. Emotional appeal	12.73	10.94	1.79*	14.13	11.44	2.69**
6. Treatment of Opposing Views	11.07	9.06	2.01	13.20	10.29	2.91*
7. Organization	12.67	10.89	1.78*	14.00	9.44	4.56**
8. Syntax	13.60	11.06	2.54*	14.33	10.78	3.55**
9. Grammar	13.20	10.89	2.31*	14.27	10.78	3.49**

*$\underline{p} < .05$. **$\underline{p} < .001$

In addition, students in the online section showed a significantly greater amount of change in logical appeal, ethical appeal, and organization than did the on-campus students. From the data, it would appear that students in the online section developed better audience awareness skills, such as use of logical, ethical, and emotional appeals, and treatment of opposing views, as the semester progressed, while the corresponding on-campus students did not. Neither section improved significantly in organization, syntax, or grammar. Scores on these three elements actually decreased for the on-campus section, although the decrease is not significant.

Age as a Confounding Independent Variable in Audience Awareness Rubric Results

Age had a moderate relationship to audience awareness scores on the first paper ($\underline{R} = 0.452$, $\underline{p} < .01$) and on the final paper ($\underline{R} = 0.522$, $\underline{p} < .01$), and a moderate relationship to the final course grade ($\underline{R} = 0.437$, $\underline{p} < .05$). When age was used as a covariate, we still found significant differences between the two sections with respect to ethical appeal, logical appeal, and organization.

Satisfaction Level Results

Students in both sections reported positive experiences with their respective classes, with similarly favorable evaluations of the instructor, with the on-campus section evaluations being slightly more favorable, but not statistically significant. Rating for the instructor in the on-campus section was an A, and in the online section, an

A-. One area in which students in the two sections differed significantly was in their perceptions of the course workload. Students in the online section perceived the workload as being more difficult ($\underline{M} = 6.23$) than did the on-campus students ($\underline{M} = 5.14$), even though the syllabus, schedule, course assignments, and deadlines were identical for the two classes, and the actual workload was identical. One explanation is that online students had significantly lower expectations of time to be spent studying as well. It could be that the contrast between their perception of the workload and the actual workload made the actual workload seem heavier. But in spite of the fact that the online students believed that they had a higher workload than students did in the on-campus class, online students overwhelmingly indicated that they would prefer to take an online class to an on-campus writing class.

Limitations

The most important limitation to this study was the fact that students self-selected into the networked and online classes, and thus did not represent a truly random sampling of populations. Additionally, the small sample size makes generalization speculative. However, as a preliminary study of online versus on-campus writing classes, the research reported in this paper was fruitful for us and provides a sound basis for further exploration on collaboration and audience awareness in computer-mediated freshman writing classes.

Conclusions

The results of this study indicate that students who enroll in an online class have characteristics that differentiate them from students who don't select into an online class. Another conclusion that we can draw from this study is that online students tend to be more independent learners, valuing collaboration less than do on-campus students. Additionally, as indicated by the higher scores in audience awareness on students' final papers in the online section, even when the scores were covaried for age, students can learn as well in an online class as in an on-campus class. Online interaction among students thus appears to increase audience awareness in students' argumentative papers. This in itself is a surprising finding. We speculated that students in the on-campus section would have the advantage of having online interaction along with face-to-face interaction. Nonetheless, this advantage did not translate significantly into improvement in students' papers while improvement among the online students was significant in several elements of audience awareness. With the increasing emphasis on distance learning, this study points to a need for further investigation of the pedagogical implications of teaching undergraduate writing courses online.

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Conceptual Change in Chemistry Through Collaboration at the Computer

Barbara Gaddis
David Anderson
University of Colorado

Abstract

This study examined the effect of computer-mediated collaboration on conceptual change in organic chemistry. Students in second semester organic chemistry laboratory performed a virtual experiment using air-sensitive alkyl lithium reagents. Students were randomly assigned to work individually at a computer (N = 21) or to work in peer dyads, with one computer per pair of students (N = 22). Dyad pairs were also assigned randomly. Prior to treatment assignment, all students took a pretest to establish baseline knowledge of organic concepts and laboratory technique. Post tests were administered immediately following treatment and one week later. The results showed that collaboration at the computer significantly improved conceptual understanding of organic theory, but did not significantly affect knowledge of laboratory techniques. This may be a result of co-construction of knowledge, negotiating shared understanding, and resolution of peer conflicts (Crook, 1994; Tao & Gunstone, 1999). Retention scores were also higher for the peer dyads, but not significantly so.

Collaboration, Computers, and Conceptual Change

While collaborative learning has been generally recognized as improving learning (Bruffee, 1993) (Chickering & Ehrmann, 1987; Dunlap & Grabinger, 1996; Johnson & Johnson, 1990; Sharan, 1980) in higher education, it has been underutilized, particularly in the science disciplines. Collaborative learning in organic chemistry has shown promising results in the lecture as well as in the laboratory (Browne & Blackburn, 1999; Glaser & Poole, 1999; Hagen, 2000).

Collaborative Learning

Collaborative learning is defined by Tao and Gunstone (1999) as "two (or more) students working together on a task that neither could do on their own prior to the collaborative engagement" (p.40). Damon and Phelps (1989) claim that collaborative learning is beneficial for tasks requiring "new insights, conceptual shifts, and the development of deep knowledge structure" (p. 40). To Saltiel (1998), the relationship between partners is as important as the knowledge being sought (p. 6). In collaborative partnerships, students help each other to accomplish more than they ever would have been able to do working individually; the partners have a shared goal or purpose; and the partners experience mutual support, respect, and loyalty. These three characteristics differentiate collaborative partnerships from merely working together or cooperation.

However, working together does not insure working effectively. Damon and Phelps (1989) describe two characteristics—equality of engagement and mutuality of engagement— that define positive collaborative peer relationships. For optimal peer learning, both partners should contribute relatively equally with both partners discussing their ideas and opinions explicitly. Crook (1994) asserts that peer collaboration offers three cognitive benefits—articulation, conflict and co-construction. Articulation refers to explicitly expressing latent ideas. Conflict refers to the processes that partners undergo to reconcile conflicting and discrepant ideas. Having resolved the apparent discrepancies, students co-construct knowledge based upon shared knowledge, scaffolding each other to greater understanding (Tao & Gunstone, 1997). The importance of each of these factors to the learning process is not clearly understood. Dunlap and Grabinger (1996) claim that collaboration facilitates learning by enabling students to go beyond their "zones of proximal development" (p. 79). Being able to share with others helps reduce risks and provides a better learning experience. Collaboration also helps students see how others solve problems and provides feedback.

Computer-mediated Collaborative Learning

Collaboration at a distance has recognizable benefits. Computer-mediated communication provides increased time for reflection (Berge, 1995; Fishman, 1997; Wells, 1993), greater equality between participants (Warschauer, 1997), greater participation, and improved work (Oblinger & Maruyama, 1996). Warshnauer (1997) reports that computer-mediated collaboration produces cognitive gains, due to the dual attributes of reflection and interaction.. While most of the research on computer-mediated collaboration has focused on online interactions

occurring either asynchronously or synchronously in chat groups (Berge, 1995; Herrmann, 1995; Koschmann, 1996; Koschmann, Feltovich, Myers, & Barrows, 1992), relatively little research has examined the effect of face-to-face collaboration at the computer on learning. However, it is clear that benefits can accrue from one-on-one communication in the classroom via the computer (Roschelle, 1992; Tao & Gunstone, 1997; Warschauer, 1997). These benefits may include increased conceptual understanding and decreased misconceptions.

Conceptions and Misconceptions

Far from being a blank slate when students come into the science classroom, students enter the classroom with preconceived ideas and theories, many of which are incorrect (Carter & Bodner, 1987; Crosby, 1987; Driver, 1989; Griffiths & Preston, 1992; Liggitt-Fox, 1997; Osborne & Cosgrove, 1983; Peterson & Treagust, 1989; Strike, 1983). One approach to reducing misconceptions is by confronting students with discrepant events, showing the mismatch between the current conception and the confronting phenomenon (Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1985, 1992). Computer laboratory simulations can provide such discrepant events, improve conceptual understanding and thereby reduce misconceptions.

Computer Simulations

Numerous attributes of computer simulations have been identified from recent literature. Computer simulations can replace experiments that use hazardous materials (Smith, Jones, & Waugh, 1986); reduce cost (Fletcher, Hawley, & Piele, 1990); replace experiments that occur too quickly or too slowly to be done in a regular laboratory period (Herron & Nurrenbern, 1999); reduce cognitive noise, so that students can concentrate on the concepts involved in the experiments (Clariana, 1989); provide feedback to enhance conceptual understanding (Chickering & Ehrmann, 1987); provide dynamic animations to emphasize the molecular level of chemical reactions (Williamson, 1992; Williamson & Abraham, 1995); allow rapid data collection (Vining, 2000); permit students to generate and test hypotheses (Joolingen & Jong, 1991); engage students with high level of interactivity (Grosso, 1993); present a simplified version of reality by distilling abstract concepts into their most important elements (White, 1993; Windschitl & Andre, 1998; Zietsman & Hewson, 1986), making abstract concepts more concrete (Rieber & Parmley, 1995); standardize instructional pedagogy, teaching, and content across multiple lab sections (Hilosky, Sutman, & Wang, 1997); actively engage students in scientific inquiry (Grosso, 1993); reduce ambiguity and help identify cause and effect relationships in complex systems (Clariana, 1989); serve as pre-laboratory preparation to aid understanding of the lab (Bobbert, 1982); foster problem-solving skills (Katkanant, 1990; LaJoie, 1993); promote critical thinking skills (Bonk & Reynolds, 1997); help students learn about the natural world through seeing and interacting with underlying scientific models that would not be readily inferred through first-hand observation (Krajcik & Lunetta, 1987); and promote conceptual change (White, 1993; Windschitl & Andre, 1998). From this literature, computer simulations clearly have the potential of improving conceptual understanding of chemical principles and theories and teaching laboratory skills.

If collaboration and computer simulations each enhance conceptual understanding, can learning from computer simulations be improved by collaboration at the computer? The present study was an attempt to answer this question.

The Study

The Virtual Organic Laboratory is a series of computer simulations designed to mirror a real organic chemistry laboratory. In the Virtual Organic Lab, students perform experiments, analyze results using spectroscopy and chromatography, and write results in their notebooks. However, the Virtual Organic Lab contains chemicals and equipment to do experiments that would be too costly or too hazardous to do on a large scale in the real laboratory. Among the virtual experiments developed thus far are oxymercuration-demercuration, alkyl lithium addition, and hydrogenation using a Paar hydrogenator.

Attributes of the Virtual Organic Laboratory

The simulations incorporate three characteristics of effective learning: animation (Rieber, 1990; Rieber & Parmley, 1995; Williamson, 1992) interactivity (Borsook & Higgenbotham-Wheat, 1991), and feedback (Azevedo & Bernard, 1995). Animations of reaction mechanisms provide learners with step-by-step pathways, demonstrating lecture concepts. Students can visualize electrons forming new bonds and bonds being broken. Experimental procedures are both animated and interactive: Students watch animated demonstrations of laboratory techniques, then set up their own equipment by dragging to the appropriate spot. They mix reagents, conduct experiments, and isolate and purify products, mirroring the very processes they would do in the laboratory

During the simulation, students receive continual feedback for both correct and incorrect choices. Students receive points for each aspect of the program that they do correctly, such as correctly calculating the theoretical yield or remembering to take the stopper out of the separatory funnel before draining. At the conclusion of the simulation students receive a detailed scorecard showing their performance in twenty categories.

The effectiveness of the simulations in improving conceptual understanding of the reaction mechanism and improving technical understanding of laboratory techniques was verified by a pilot project during Fall, 1999. Students using the simulation had significantly higher scores than students who did not do the simulation ($X_s = 8.82$; $X_{ns} = 3.83$; $F = 21.45$, $p = 0.001$). However, these scores were still unacceptably low. In an effort to improve learning outcomes, we decided to investigate how collaboration at the computer affects conceptual understanding.

Design of the Study

During Spring, 2000, students in each organic chemistry laboratory section were randomly divided into two treatment groups with one group of students ($N = 21$) working individually on the computer simulation and the other group of students ($N = 22$) randomly paired into peer dyads. The dyad pairs worked collaboratively on one computer simulation. Prior to treatment assignment, students took a pretest to assess extant knowledge and understanding of organic reaction mechanisms, inert gas chemistry, alkyl lithium reactions, and other organic chemistry techniques. The students also completed a survey to assess their attitudes about collaboration and the laboratory. After doing the simulation, students completed a post test and attitudinal survey.

Results of the Study

Prior to treatment, the two groups of students were comparable, with no significant academic or attitudinal differences between the two groups. Both groups had similar pretest scores ($X_c = 29.9\%$ and $X_i = 36.5\%$). Grades in the previous semester lecture were similar ($X_c = 3.49$ and $X_i = 3.59$), as were the grades received in the previous semester organic chemistry lab ($X_c = 3.56$ and $X_i = 3.51$, out of 4.00). Both groups held similar views about the importance of collaboration ($X_c = 3.52$ and $X_i = 3.52$, out of 5.00) and organic chemistry laboratory ($X_c = 2.55$ and $X_i = 2.52$, out of 5.00).

After treatment, however, there were some significant differences in performance on the post test, with students in peer dyads significantly outperforming students who worked individually ($X_c = 63.2\%$, $X_i = 54.9\%$, $F = 7.920$, $p < 0.01$). Peer dyads significantly outperformed individual users on conceptual questions relating to the reaction mechanism ($X_c = 83.0\%$ and $X_i = 64.9\%$, $p < 0.01$). The students in peer dyads also scored higher on questions relating to laboratory techniques and instrumentation; however the differences were not significant ($X_c = 59.6\%$, $X_i = 54.0\%$, $p > 0.05$). The results imply that understanding organic theory requires different learning strategies than does laboratory technique understanding. Conflict (Cook & Cook, 1998) and peer discussion (McMillan, 1997; Winiecki, 1999) may aid student understanding of complex mechanisms. Collaboration at the computer facilitates this type of peer interaction. On the other hand, gaining laboratory expertise and understanding the practicalities and theory behind laboratory techniques and instrumentation may not benefit as much from discussion and the learning advantages of peer discussion may be partially compensated by individual use of the simulation.

A retention test was administered two weeks after the simulation laboratory sessions. Again, students in peer dyads outperformed students who worked individually on both the mechanism and laboratory techniques sections of the retention test. However, due to the small number of questions in both sections, the differences between the groups were not significant and no generalizations can be drawn.

Interestingly, although pretest scores were moderately correlated to grade in first semester organic chemistry class, post test scores for both groups were not significantly correlated to grade students received in the first semester organic chemistry class. This result suggests that computer simulations improve scores for lower performing students. This result contradicts the research of Vaidyanathan and Rochford (1998) who found that students who performed well on lecture exams also performed well in computer simulations.

Attitudinal Results

There were no significant differences in attitudes towards the computer simulation: ($X_c = 18.4$ and $X_i = 19.4$, $F = 0.870$, $p = 0.357$)). Both groups of students thought they had learned well from the computer simulation, with the majority of students agreeing that the Virtual Organic Laboratory simulation had helped them understand the mechanism and reactivity of organic lithium reactions (69.7%), the techniques of conducting air-sensitive reactions (95.3%), and the theory and practice of extractions (81.4%). The percentages refer to the percent of students strongly agreeing with the indicated statements. Both groups were also very positive about using the computer simulations, with 93.0% of all students strongly agreeing that the Virtual Organic Laboratory simulation

was fun and 85.7% of the students wanting to use the simulations used for other experiments. Over half of the students (62.8%) indicated that they felt as though they had carried out a real laboratory experiment and 69.8% believed that doing the simulation was a better learning experience than doing an actual laboratory experiment. Factor analysis was performed to understand students' preference for computer simulations over laboratory experiments. Two factors were isolated that explained students' satisfaction with computer simulations. Factor one ($\alpha = 0.8696$) related to confidence: Doing the simulation improved students' confidence in doing lab work. Factor two ($\alpha = 0.8932$) related to time: Students thought that doing the simulation made learning more efficient and saved time. There were no significant differences between the collaborative and non-collaborative groups in either factor.

Conclusions

Two general conclusions can be drawn from this research. First, students who work collaboratively at the computer gain greater understanding of mechanisms and reactivity than students who work alone. Working together gives students an opportunity for peer conflict, discussion, and co-construction of knowledge (Crook, 1994). Students working in pair dyads must verbalize their existing conceptions as they attempt to make sense and incorporate new and discrepant information. This requires that students summarize their existing ideas in order to share. The act of verbalization may also serve as a catalyst to recognize erroneous ideas and perhaps modify concepts. Students who work alone do not have a peer to sound new ideas and are not challenged to explain existing conceptions. As a result, students who worked individually may not have as much opportunity to recognize inadequate conceptions or to give up alternative concepts.

A second conclusion is that computer simulations enhance students' enjoyment of the laboratory. Regardless of whether students worked individually or collaboratively, students felt cognitively engaged in doing the simulation and felt as though they had learned a substantial amount of the theory and practice of working with alkyl lithium reagents. This finding is corroborated by numerous other studies (Escalada & Zollman, 1997; Kulik, 1994; Strauss & Kinzie, 1994; Zirkel & Zirkel, 1997). Students felt that they learned more efficiently from the computer simulation and felt confident that they had learned the techniques well.

Most students indicated that they prefer computer simulations to hands-on laboratory work. This may be due to the novelty effect of doing computer simulations and the perception of computer simulations as requiring less time than performing a real experiment. However, other six other attributes of the computer simulation contribute to their preference for computer simulation over traditional wet laboratory experiments: (a) Students aren't limited to safe, inexpensive, and available chemicals, but can do a wide range of reactions, illustrating and supporting concepts learned in lecture. (b) Students can repeat an experiment as many times as necessary to understand the concepts, mechanism, or procedural attributes of the experiment. (c) Students can gain experience using expensive equipment or complex spectroscopic techniques. (d) Students can practice a technique before they have to do it in lab, thereby improving their confidence in doing lab work. (e) Students can make mistakes without risking time, money, or safety. (f) Students can get rapid, almost instant, feedback, thereby improving learning. In addition to these cognitive benefits, the Virtual Organic Laboratory simulations offer another practical benefit: Students can do the lab any time of the day, from anywhere in the world.

While computer simulations will never replace traditional laboratory experiments, laboratory simulations may be the answer to the increasing need to deliver a pedagogically sound laboratory experience in distance science courses. Regardless of whether students are at a distance or face to face, computer simulations can enhance learning, particularly if students are allowed to collaborate, either at the computer or in cyberspace.

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What and How Do Designers Design? A Theory of Design Structure

Andrew S. Gibbons
Utah State University

Abstract

A question I always ask my Instructional Technology students at Utah State University is, "What do instructional designers design?" We have had interesting discussions on this question, and I try to revisit the question at several points throughout all of my classes. I find that the students' perceptions of what instructional designers design changes over time. This is no doubt a product of the faculty's teaching, but it also represents a personal commitment that the student makes. What the student commits to is what I would like to talk about. My thesis will be that it is a commitment to a particular layer of the evolving instructional design. I will talk about the layering of instructional designs and the implications for both teaching and practicing instructional design.

"The Centrisms"

Here are some of the phases I see students evolving through as they mature in their theoretic and practical knowledge:

Media-centrism. Media-centric designs place great emphasis on the constructs related to the instructional medium. The technology itself holds great attraction for new designers, They often construct their designs in the vocabulary of the medium rather than seeing the medium as a plastic and preferably invisible channel for learning interaction (See Norman, 1988; 1999). We are currently experiencing a wave of new media-centric designers due to the accessibility of powerful multimedia tools and large numbers of designers "assigned into" computer-based and Web-based training design. Most of these designers speak in terms of the medium's constructs (the "page," the "hyperlink,", the "site," etc.) as the major design building blocks. Many struggle as they attempt to apply inadequate thought tools to complex design problems.

Message-centrism. Realizing that media design building blocks do not automatically lead to effective designs, most designers begin to concentrate on "telling the message better" in order to "get the idea across" or "make it stick." This is a phase I call message-centrism. Message-centric design places primary importance on message-related constructs and employs media constructs—main idea, explanation, line of argument, dramatization, etc.— secondarily, according to the demands of the message. The media constructs are used, but they are used to serve the needs of better messaging. Better message "telling" means different things to different designers: providing better illustrations, using animations, wording the message differently, using analogies, or focusing learner attention using attention-focusing questions, emphasis marks, repetition, or increased "interactivity."

Strategy-centrism. Message-centrism is normally followed by a recognition of underlying structural similarities within messages and interactions that cross subject-matter boundaries and that have important instructional implications. This leads to a new viewpoint I call strategy-centric design thinking. Strategy-centrism considers the structured plan of messaging and interaction as a main source of instructional effectiveness. Therefore, the designer's first attention is to strategic constructs that are appropriate to instruction in categorized varieties of learning. Strategy-centric design can be viewed as the use of rules to governing the delivery of compartmentalized information and interaction elements (Gagne, 1985; Merrill, 1994). This can be a very useful conception for both the designer and the learner, and structured strategy is an important key to logic templating and design automation.

Model-centrism. Whereas strategy centrism permits the use of instructional experts (Zhang, Gibbons, & Merrill, 1997), it does not lead the designer to design interactive micro-worlds in which instruction can take place through problem solving. This realization leads to model-centered design thinking. Model centering encourages the designer to think first in terms of the system and model constructs that lie at the base of subject-matter knowledge. The designer therefore gives first consideration to identifying, capturing, and representing in interactive form the substance these constructs. Then to this base of design is added strategy, message, and media constructs. Model-centrism is the common thread running through virtually all new-paradigm instructional approaches (for a review, see Gibbons & Fairweather, 2000). Many current researchers consider learning to be a problem-solving activity (Anderson, 1993; Brown & Palincsar, 1989; Schank, 1994; VanLehn, 1993). If this view is correct, then the designer

must also give first preference to decisions about the problems the learner will be asked to solve. A model-centered view prescribes instructional augmentations that support problem solving in the form of coaching and feedback systems, representation systems, control systems, scope dynamics, and embedded didactics (see Gibbons, Fairweather, Anderson, & Merrill, 1997).

These phases in the maturation of design thinking tend to be encountered by new designers in the same order, and one could make the argument that these phases describe the history of research interests in the field of instructional technology as a whole. A good place to see this trend in cross-section is the articles in *the Annual Review of Psychology* beginning with the review by Lumsdaine and May (1965) and progressing through subsequent chapters by Anderson (1967); Gagne & Rohwer (1969); Glaser & Resnick (1972); McKeachie (1974); Wittrock & Lumsdaine (1977); Resnick (1981); Gagne & Dick (1983); Pintrich, Cross, Kozma & McKeachie (1986); Snow & Swanson (1992); Voss, Wiley & Carretero (1995); Sandoval (1995); VanLehn (1996); Carroll (1997); Palincsar (1998); and Medin, Lynch & Solomon (2000).

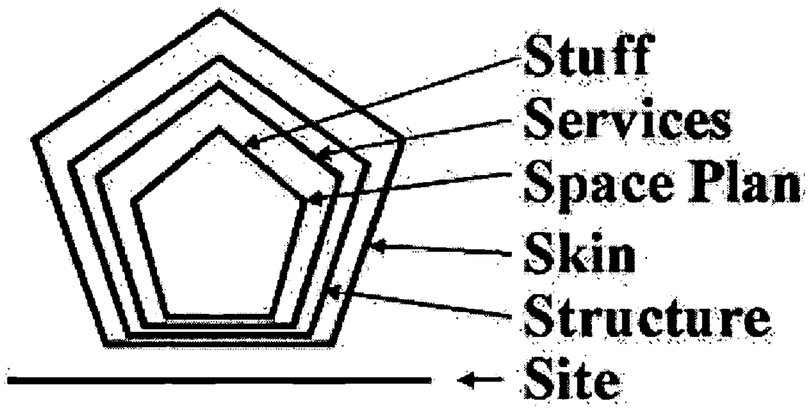
Roots of the "Centrisms"

I am interested in this paper in exploring the roots of this progression. Important clues can be found in design areas outside of *instructional* design. A provocative statement on design structure is given by Brand (1994) in a description of how buildings are seen by architects and structural engineers. Brand begins by stating that architects see a building as a system of layers rather than as a unitary designed entity. He names six general layers, illustrated in Figure 1 and described below in his own words:

- SITE – This is the geographical setting, the urban location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings. "Site is eternal," Duffy agrees.
- STRUCTURE – The foundation and load-bearing elements are perilous and expensive to change, so people don't. These **are** the building. Structural life ranges from 30 to 300 years (but few buildings make it past 60, for other reasons).

Figure 1. Layers of building design.

- SKIN – Exterior surfaces now change every 20 years or so, to keep with fashion and technology, or for wholesale repair. Recent focus on energy costs has led to reengineered Skins that are air-tight and better insulated.
- SERVICES – These are the working guts of a building: communications wiring, electrical wiring, plumbing, sprinkler system, HVAC (heating, ventilating, air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every 7 to 15 years. Many buildings are demolished early if their outdated systems are too deeply embedded to replace easily.
- SPACE PLAN – The interior layout—where walls, ceilings, floors, and doors go. Turbulent commercial space can change every 3 years or so; exceptionally quiet homes might wait 30 years.
- STUFF – Chairs, desks, phones, pictures, kitchen appliances, lamps, hair brushes; all the things that twitch around daily to monthly. Furniture is called **mobilia** in Italian for good reason. (p. 13)



Brand points out some important implications of the layered view of design:

1. That layers of a design age at different rates
2. That layers must be replaced or modified on different time schedules
3. That the layers must be articulated with each other somehow
4. That designs should provide for articulation in such a way that change to one layer entails minimum disruption to the others.

In work for the Center for Human-Systems Simulation, my colleagues Jon Nelson and Bob Richards and I have applied Brand's ideas to instructional design (Gibbons, Nelson & Richards, 2000). We have found that instructional designs can indeed be conceived of as multiple layers of decision making with respect to different sets of design constructs, and we find a rough correspondence between the layers and the phases of designer thinking already described. Gibbons, Lawless, Anderson and Duffin (in press) show how layers of a design are compressed at a "convergence zone" with tool constructs that give them real existence and embody them in a product.

Tables 1 through 7 at the end of this paper summarize what we think are the important layers of an instructional design: model/content, strategy, control, message, representation, media-logic, and management. Each layer is characterized in the tables by the following:

- A set of design goals unique to the layer
- A set of design constructs unique to the layer
- A set of theoretic principles for the selection and use of design constructs
- A set of design and development tools
- A set of specialized design processes

In addition, a layer often corresponds with a set of specialized design skills with its own lore, design heuristics, technical data, measurements, algorithms, and practical considerations. The boundaries of these skills over time tend to harden into lines of labor division, especially as technical sophistication of tools and techniques increases.

More detailed principles of design layering are outlined in Gibbons, Nelson, and Richards (2000). The purpose of the present paper is to show how design layering influences the designer's thinking and allows it to change over time into entirely new ways of approaching the design task. The media-, message-, strategy-, and model-centric phases designers experience can be explained as the necessary focus of the designer first and foremost on a particular layer of the design. That is, the designer enters the design at the layer most important to the design or with which the designer is most familiar and comfortable.

Media-centric designers do not ignore decisions related to other layers, but because they may not yet be fully acquainted with the principles of design at other layers, they naturally think in terms of the structures they do

know or can acquire most rapidly—media structures. As designers become aware of principles at other layers through experience and the evaluation of their own designs, focus can shift to the constructs of the different layers: message structurings, strategy structurings, and model and content structurings. Each step of the progression in turn gives the designer a new set of constructs and structuring principles to which to give the most attention, with other layers of the design being determined secondarily, but not ignored.

Is there a "right" layer priority in designs? Should designers always be counseled to enter the design task with a particular layer in mind? It is not possible to say that, because design tasks most often come with constraints attached, and one of those constraints may predetermine a primary focus on a layer. An assignment to create a set of videotapes will lead the designer to pay first and last attention to the media-logic and representation layers, and other layers are forced to comply with the constraint within the limits of the designer's ingenuity.

Conclusion

The design layering concept has many implications. In this paper I have explored one of them that explains the maturation in designer thinking over time. In order to move to a new perspective of design it is not necessary to leave older views behind. The new principles added as the designer becomes knowledgeable about each new layer adds to the designer's range and to the sophistication of the designs that are possible. Further consideration of the layering concept will expand our ability to communicate designs in richer detail, achieve more sophisticated designs, and add to our understanding of the design process itself.

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Attachment A.
Design Layering Principle:
Application to Instructional Design
From Gibbons, Nelson & Richards (2000)

Table 1: Model/Content Layer Description

Layer Design Goals	*Common Layer Design Constructs*
To define the units of content segmentation To define the method of content capture To gather content elements To articulate content structures: With the Strategy layer With the Control layer With the Message layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Model Relation Production rule Working Memory Element Proposition Fact Concept Rule Principle Task Task grouping Theme Topic Main idea Semantic relationship Chapter
Design Processes: Task Analysis, Cognitive Task Analysis, Rule Analysis, Content Analysis, Concept Mapping	
Design/Production Tools: Data base software, Analysis software	

Table 2: Strategy/Event Layer Description

Layer Design Goals	*Common Layer Design Constructs*
To define event structures (time structures) To define event hierarchies To define rules for event generation To articulate strategy structures: With the Content layer With the Control layer With the Message layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Problem Information event Interaction event Exercise Instructional period Discovery challenge Unit Lesson Strategy component Argument Argument support
Design Processes: Strategy planning, Problem planning, Challenge formation, Activity planning, Exercise design	
Design/Production Tools: Data base software	

Table 3: Control Layer Description

Layer Design Goals	Common Layer Design Constructs
To define the set of possible user actions To define the rules of control availability To define the rules for control action To define the rules/processes for response recognition, parsing, and judging To articulate control structures: With the Content layer With the Strategy layer With the Message layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Menu item Administrative control Strategy control Message control Representation control Logic control Content control Forward, Back Play, FF, FR, Stop, Pause Exit, Quit
Design Processes: Flow planning, Control walk-through, Diagramming	
Design/Production Tools: Flowcharting, GUI-logic construction authoring systems	

Table 4: Message Layer Description

Layer Design Goals	*Common Layer Design Constructs*
To define message types To define message composition by type To define rules for message generation To articulate message structures: With the Content layer With the Strategy layer With the Control layer With the Representation layer With the Logic layer With the Management layer	(Incomplete sample list) Main idea Example Non-Example Discussion block Commentary Advance organizer Primitive message element Spatial relationship Temporal relationship Causal relationship Hierarchical relationship Explanation Stem Distractor Response request Transition message Goal statement Directions "Resource" Database entry Coaching message Feedback message Hint
Design Processes: Message design, Strongly related to Strategy design	
Design/Production Tools: Timeline-building tools, Flow diagrams	

Table 5: Representation Layer Description

Layer Design Goals	Common Layer Design Constructs
To select media To define media channels To define channel synchronizations To define representation structures by type To select representation production tools To match production tool structures To define rules display structure To define rules for display generation To define rules for structure generation To define rules for display management To articulate representation structures: With the Content layer With the Strategy layer With the Control layer With the message layer With the Logic layer With the Management layer	(Incomplete sample list) Background Resource file (audio, video) Resource file (BMP, JPG, GIF, MPG) Headline, Body Placeholder 3-D object Rendering Animation Tag parameter Sprite Control icon Layer (e.g., Photoshop, Dreamweaver)
Design Processes: Display design, Formatting, Display event sequencing, Media channel synchronization, Media channel assignment	
Design/Production Tools: All content/resource production tools for all media, All layout or formatting tools for all media, Display managers	

Table 6: Logic Layer Description

Layer Design Goals	*Common Layer Design Constructs*
To define media-logic structures by type To define rules to apply logic structures To select logic construction tools To define segmentation/packaging plan To define logic distribution plan (time) To articulate logic structures: With the Content layer With the Strategy layer With the Control layer With the Message layer With the Representation layer With the Management layer	(Incomplete sample list) Display Branch Program Command Procedure Program object Applet Application Book, object Movie, stage, actor Object, Method, Data Site, Page
Design Processes: Program design, Program construction	
Design/Production Tools: All logic production tools, Modeling languages (e.g., UML)	

Table 7: Management Layer Description

Layer Design Goals	*Common Layer Design Constructs*
To define session control rules/procedures To define the rules for initiative sharing To define transition between events To define record keeping and recording To define variable-keeping and use To define outside communications: Host, Peer, Net, Libraries, Databases To define data reporting: Learner, Instructor, System To plan security/privacy policy/provisions To plan evaluation activities To plan implementation activities To plan management activities To articulate management structures: With the Content layer With the Strategy layer With the Control layer With the Message layer With the Representation layer With the Logic layer	(Incomplete sample list) Menu Record Variable Database entry
Design Processes: Management planning, Implementation planning, Evaluation planning	
Design/Production Tools: Data base software	

Teaching and Learning Strategies for Complex Thinking Skills

Lucy A. Goodson
Florida State University

Abstract

This paper proposes a model for teaching and learning complex thinking skills developed from a synthesis of theories and research. The model functions like a concept map or a graphic organizer with five major components: (1) presence of complex authentic life situations within a context; (2) activation and execution of complex thinking skills; (3) development of interactive prerequisites of content, simple thinking skills, and dispositions and habits; (4) inclusion of connecting networks and operations (linkages, schemata, and scaffolding) to bridge complex thinking skills with interactive prerequisites; and (5) targeted teaching and learning strategies. Terms associated with thinking and learning guided the manual and electronic search through the Internet and on-line library files.

Background

There are known instructional strategies to support the learning of different types of knowledge and skills (Merrill, Drake, Lacy, Pratt, & the ID2 Research Group, 1996), and for the most part, these were identified by observing the conditions of learning across six decades of study. Classifications of learning outcomes tend to progress from simple to complex (Bloom, 1956; Briggs & Wager, 1981; Bruner, 1990; Clarke, 1990; Dewey, 1933; Gagné, 1985, 1989; Gagné & Briggs, 1974; Gagné, Briggs, & Wager, 1988; Costa, 1990; Cotton, 1997; Glaser, 1941; Guilford cited in Crowl et al, 1997; Haladyna, 1997; Jonassen, n.d.; Marzano, 1993, 1994; Marzano, et al, 1992; Marzano, et al, 1988; Merrill, 1987; Merrill et al, 1996; McREL, 1997; Piaget cited in Crowl et al, 1997; Sternberg, 1998; Sternberg & Davidson, 1995; Sugrue, 1995; Vygotsky cited in Crowl et al, 1997).

Many publications cite the distinction between lower order and higher order thinking skills (Arter & Salmon, 1987; Carnine, 1993; Clarke, 1990; Ennis, 1989; Fogarty & McTighe, 1993; Crowl et al, 1997; Kauchak & Eggen, 1998; Kirby & Kuykendall, 1991; Lewis & Smith, 1993; McDavitt, 1993; McGregor, 1993; Paul & Nosich, 1992; Weisberg, 1995; Young, 1997). Some refer to tasks requiring *increased levels of processing* (cognitive: classifications, rule or procedural executions) and others to tasks demanding *high levels of processing* (constructive: heuristic problem solving, personal selection and monitoring of cognitive strategies) (Ertmer & Newby, 1993).

Yet, the definition of complex thinking skills has been referred to as a *conceptual swamp* (Cuban cited in Lewis & Smith, 1993, p. 1) and ...a *century old problem* for which *there is no well-established taxonomy or typology* (Haladyna, 1997, p. 32). What is unknown also has been described as follows.

> ...*While advanced knowledge, higher order thinking, problem solving, and transfer of learning evoke common associations and expectations in most of us, there remains an operational inexactitude in these constructs..these learning outcomes can best be operationalized and predicted by assessing and understanding learners' mental models of the problem or content domain being learned....*
>
> Jonassen, n.d., p. 1

A Model for Teaching and Learning Strategies

Figure 1 represents a synthesis from theories of learning and research associated with complex thinking skills. This model functions like a concept map or graphic organizer (Ausubel, 1968; Clarke, 1990; Kealy, 2000; Jonassen, 1996; NCREL, 1988; Novak, 1990; Plotnick,1997). It shows components, linkages, relationships, and interactions for teaching and learning complex thinking skills. The narrative further explains the relationships among the five components: (1) presence of complex authentic life situations within a context; (2) activation and execution of complex thinking skills; (3) development of interactive prerequisites of content, simple thinking skills, and dispositions and habits; (4) inclusion of connecting networks and operations (linkages, schemata, and scaffolding) to bridge complex thinking skills with interactive prerequisites; and (5) targeted teaching and learning strategies.

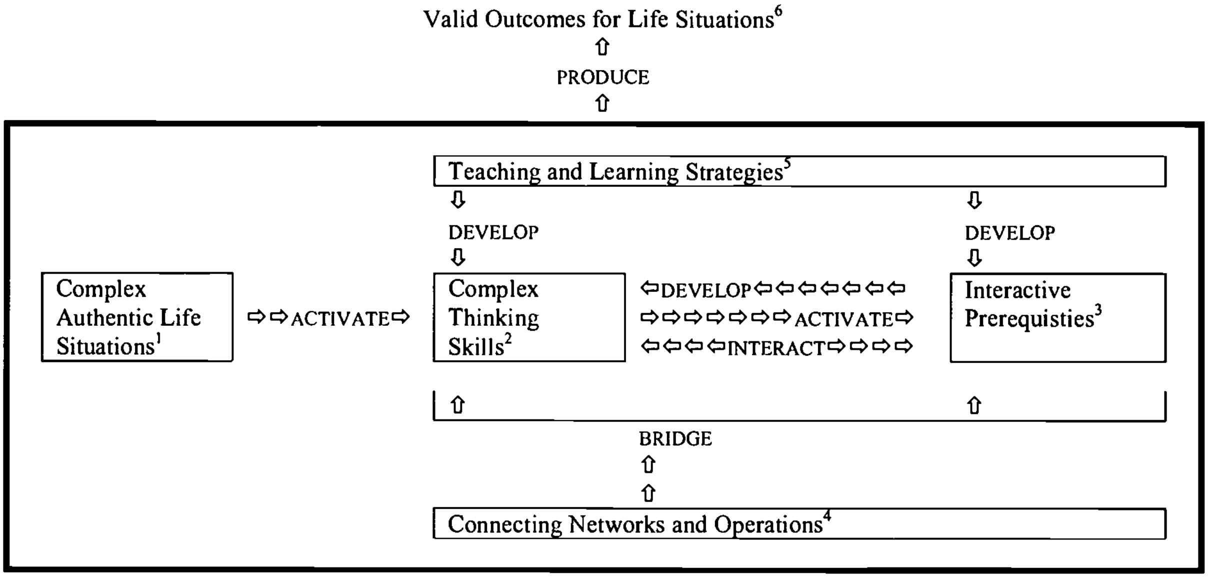

Figure 1. A Model for Teaching and Learning Complex Thinking Skills

[1]**Authentic Life Situations.** Situations of multiple categories for which the student has not learned answers, preferably real-life context. Examples: ambiguities, challenges, confusions, dilemmas, discrepancies, doubt, obstacles, paradoxes, problems, puzzles, questions, uncertainties.
[2]**Complex Thinking Skills.** Multidimensional skills using more than one rule to manage a life situation or transforming known concepts and rules to fit the situation. Examples: complex analysis, creative thinking, critical thinking, decision making, evaluation, logical thinking, metacognitive thinking, problem solving, reflective thinking, scientific experimentation, scientific inquiry, synthesis, systems analysis.
[3] **Interactive Prerequisites.** Content, simple thinking skills, and learner dispositions and habits.
Content. Content includes subject area content (vocabulary, structure, concept definitions, procedural knowledge, reasoning patterns) and thinking content (thinking terms, structures, strategies, heuristics, and processes).
Simple thinking skills. Simple thinking skills include cognitive strategies, comprehension, concept classification, discriminations, routine rule using, simple analysis, and simple application.
Dispositions and habits. Dispositions and habits include attitudes, adaptiveness, tolerance for risk, flexibility, openness; cognitive styles (such as field dependence, locus of control, response rates); habits of mind (persistence, self-monitoring, self-reflection); multiple intelligences (linguistic-verbal, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal).
[4] **Connecting Networks and Operations.** Bridges between interactive prerequisites and complex thinking skills related to the life situations by means of linkages, schemata, and scaffolding.
Linkages. Linkages involve the extension of prior learning to the new context and higher order skills. They may require mastery or automatization of prior learning. It is important to link new knowledge and skills with prerequisites.
Schemata. Schemata may be a network, organization, representation, or architecture for organizing new learning so that it makes sense to the learner.
Scaffolding. Scaffolding includes the guidance, structure, visual and verbal representations, and modeling of complex thinking skills.
[5]**Teaching and Learning Strategies.** Teaching and learning strategies for the interactive prerequisites and complex thinking skills provided in a learning environment that is considered safe, motivating, and supportive. Learning progresses in levels, each elaborating on previous levels, and connecting previously learned knowledge and skills to the next higher level.
[6] **Valid Outcomes for Life Situations.** Outcomes will be valid for life situations when they are managed or resolved within their context, including conditions, resources, constraints, and criteria.

Complex thinking skills will develop more fully when teachers and instructional programs align learning activities with authentic life situations and provide scaffolding to help learners move from simple through progressively more complex content, processes, and outcomes. In life situations, individuals must be able to select, organize, and sequence knowledge, thinking skills, and dispositions relevant to the life situations that they encounter. They must be able to apply content knowledge and thinking models or strategies to productively manage various life situations.

In order to develop the cognitive structure that is most consistent with complex thinking skills, learners must have opportunities to achieve increased generality and complexity in thinking applications, with practice beginning within the lower-order levels of content and learning outcomes. The importance of developing this cognitive structure and the role of guidance and practice has been well established (Merrill, 1987). The benefit for progressive movement from simple to increasing complexity also has been well established (Ausubel, 1968; Clarke, 1990; Crowl et al, 1997; Kauchak & Eggen, 1998; Marzano et al, 1988; McREL, 1997; Wilson & Cole, 1992).

Authentic Life Situations

Knowledge develops within each individual through learning events in education and everyday life (Bruner, 1990; Dewey, 1933; Jonassen, 1999). Most problem situations are multicategorical and not domain-specific (McPeck, 1990). An action-based learning environment depends on immersion with real-world or authentic problems (Ausubel, 1968; Dewey, 1933; Glaser, 1941; Huot, 1998; Jacobs, 1995; Jonassen, 1999; Jonassen, Merrill, Reigeluth, and Rowland, 2000; Marzano et al 1988; McREL, 1997; Vygotsky, 1978). Yet, life engages people in many situations that may require complex thinking, not just problems to be solved.

In addition to problem solving, other purposes achieved through complex thinking skills include finding problems, incompleteness, anomalies, troubles, inequities, and contradictions; developing methods of inquiry; making decisions; making choices, creating new ideas or objects, and making predictions (Cotton, 1997; Gagné, Briggs & Wager, 1988; Kahneman, Slovic & Tversky, 1982; Lewis & Smith, 1993; McREL, 1998; Tversky & Kahneman cited in Ohio State University, n.d.; Wilson & Cole, 1992).

Complex Thinking Skills

Complex thinking skills encompass the higher level skills defined in Bloom's Taxonomy of Educational Objectives (Bloom, 1956); the problem-solving level of skills in the hierarchy of learning capabilities described by Briggs and Wager (1981), Gagné (1985), and Gagné, Briggs, and Wager (1988); the critical thinking skills identified in Gubbins' *Matrix of Critical Thinking Skills* (cited in Legg, 1990); and the kinds of critical thinking, problem solving, decision making, and creative thinking skills described by Lewis and Smith (1993).

Terms used to describe complex thinking skills have been diverse, including active inquiry and discovery, creative thinking, critical thinking, decision-making, evaluation, higher order thinking, inquiry, insight, logical thinking, metacognition, problem solving, scientific reasoning, rational thinking, reflective thinking, synthesis, and systems analysis (Bloom, 1956; Bruner cited in Crowl et al, 1997; Cotton, 1997; Crowl et al, 1997; Csikszentmihalyi & Sawyer, 1995; Dewey, 1933; Ennis, 1989, 1993; Facione, 1998; Fogarty & McTighe, 1993; Gagné, Briggs & Wager, 1988; Gick & Lockhart, 1995; Glaser, 1941; Gruber, 1995; Haladyna, 1997; Kahneman, Slovic & Tversky, 1982; Kauchak & Eggen, 1998; Legg, 1990; Lewis & Smith, n.d., McREL, 1998; Piaget cited in Crowl et al, 1997; Pogrow, 1999; Pogrow & Buchanan, 1985; Siowick-Lee, 1995; Sternberg & Davidson, 1995; Tversky & Kahneman cited in Ohio State University, n.d.; Utah State Office of Education, 1997).

For the purpose of focusing the model presented in this paper, a complex thinking skill is one that involves the application of at least two rules or principles to a situation with multiple factors. It is *productive* rather than only *reproductive* thinking (Maier cited in Lewis & Smith, n.d., p. 6). It requires going beyond applying routine rules, beyond the routine application of previously learned knowledge (Newman cited in Lewis & Smith, n.d., pp. 7-8). It may involve the *putting together of certain rules that may not have been applied to previous similar situations* (Gagné, Briggs & Wager, 1988, pp. 65-66). In this process, concepts and rules must be *synthesized into new complex forms for the learner to cope with new problem situations* (Gagné, Briggs & Wager, 1988, pp. 65-66).

In Gagné's framework, intellectual skills begin with discriminations as a prerequisite for concrete and defined concepts, simple rules, and then more complex higher order rules and problem solving. The application of at least two rules defines the problem solving level of learning (Briggs & Wager, 1981; Gagné, 1985; Gagné, Briggs & Wager, 1988).

Though focused on process or biological development or stages of development, other learning theories also express levels of increasing complexity. For example, in Bloom's taxonomy, lower levels of learning provide a base for higher levels of analysis, synthesis, and evaluation. Piaget and Bruner focus on different processes for acquiring skills, but both include the importance of linking previously learned concepts and information to new

learning (Crowl et al, 1997; Hummel 1997). Bruner's spiral curriculum has long served as a model for developing higher levels of complexity over periods of time (Bruner cited in Crowl et al, 1997). Vygotsky observed that cognitive development progresses as children learn and that internalizing knowledge facilitates higher mental functions (Crowl et al, 1997). Finally Marzano and McREL have focused on developing dimensions of thinking and learning in which core thinking skills and more complex thinking processes interact with types of knowledge (Marzano et al, 1988; McREL 1997).

It is most important that individuals make *acquaintance with the particular facts that create a need for definition and generalization* in order to see *the correct difficulty to be overcome* not with *definitions, rules, general principles, classifications, and the like* (Dewey, 1933, p. 186). Perceiving the correct difficulty is particularly important because the way a problem is *apprehended or defined limits the kind of answers that will occur to the thinker* (Glaser, 1941, p. 25). Individuals must be able to reformulate issues and steer the thinking process in the right direction.

Individuals must be able to combine new with familiar information and skills creatively within limits set by the material or context (Bloom, 1956; Bloom cited in McDavitt, 1993). The interplay of multiple intelligences, insight, and creativity also fits within the concept of complex thinking skills.

Intelligence, no longer limited to the idea of a single ability or global capacity to learn, is characterized by multiple dimensions of mental processes, types of information, and types of outcomes involving convergent and divergent thinking (Crowl et al, 1997). These different abilities contribute to success with different types of subject matter content, approaches to thinking strategies, and ways of coping with new and unfamiliar life situations (Guilford cited in Crowl et al, 1997; Thurstone cited in Crowl et al, 1997; McPeck, 1990; Gardner, 1983; Gardner cited in Crowl et al, 1997; Sternberg, 1998; Sternberg & Lubart, 1995; Sternberg cited in Crowl et al, 1997).

Insight, a concept often associated with creativity, manifests itself in the sudden unexpected solution to a problem (Schooler, Fallshore, & Fiore, 1996). Non-insight problems require routine application of rules, while insight problems require problem solving and cognitive strategies or analysis, synthesis, and evaluation (Gagné, Briggs & Wager, 1988; Bloom, 1956). Insight may be a product of the prepared mind because *only a trained mind can make connections between unrelated events, and recognize meaning in a serendipitous even,* and produce a solution which is both novel and suitable (Pasteur cited in Crowl et al, 1997, pp. 192-193). Insight has been characterized as involving the access of appropriate problem elements, the search for a new problem representation, the finding of alternative approaches, the habit of persevering, the taking of risks, the application of broad knowledge, and the recognition and use of analogies (Schooler, Fallshore & Fiore, 1995).

Creativity, often characterized by fluency, originality, and elaboration, requires going beyond previously learned concepts and rules to generate rather than merely reproduce something (Crowl et al, 1997). Creative problem solving involves finding problems, working to find fresh ways to view them, evaluating shortcomings and weaknesses, selecting relevant aspects for attention while ignoring the irrelevant, and putting the pieces together in a coherent system that integrates the new information with what an individual already knows (Barron & Harrington cited in Crowl et al, 1997; Hebb, Perkins, & Smith cited in Sternberg & Davidson, 1995; Sternberg & Davidson, 1982, 1983; Davidson & Sternberg cited in Crowl et al, 1997). Examples of products resulting from the creative process include Benjamin Franklin's application of conservation and equilibrium (Crowl et al, 1997); Picasso's *Guernica* resulting from sketches and modifications of previous work (Weisberg, 1995); Coleridge's *Kubla Khan,* a product of numerous revisions (Crowl et al, 1997); Watson and Crick's discovery of the DNA double helix structure (Weisberg, 1995; Crowl et al, 1997; Edison's invention of an electric lighting system (Weisberg, 1995; Crowl, 1997).

In this model, metacognitive strategies have been classified as complex thinking with the focus on their executive control function—evaluating, planning, and regulating thinking processes. Some metacognitive strategies might be considered simple thinking skills, while others would be complex. Metacognitive strategies include problem finding and the linkage of problem finding and creativity through activities of planning, self-monitoring of progress, and self-adjustments to thinking strategies (Gagné, Briggs & Wager, 1988; Sternberg & Lubart, 1995; McREL, 1998; Young, 1997).

The cognitive development involved in complex thinking also leads to more efficient learning of both facts and skills (DeVries & Kohlberg, 1987; McDavitt, 1993; Schwartz & Reisberg cited in Crowl et al, 1997; Son & VanSickle, 1993).

Interactive Prerequisites

Content is a building block for thinking skills. The recall of content is verbal information. Whether or not thinking can be learned without content is only a theoretical point because education and life engage both. Individuals take current knowledge and interrelate or rearrange it together with new information, using thinking

skills, which then function to extend and refine knowledge (Huot, 1998; Marzano et al, 1988; McREL, 1997). As learners build relationships among concepts, they broaden their knowledge of the world and begin to form rules to use in problem situations (Gagné, Briggs & Wager, 1988).

Content *begins in relatively simple forms and grows towards complexity* and the nature of thinking *adapts to increasing challenge* (Clarke, 1990, p. 24). Mastery of content and simple thinking skills are particularly important prerequisites because *any lesser degree of learning...will result in puzzlement, delay, inefficient trial and error at best, and in failure, frustration, or termination of effort toward further learning at the worst* (Gagné, Briggs & Wager, 1988; cf. Bloom cited in McDavitt, 1993).

Examples of objectives that express the need for complex thinking skills in particular subject matter areas include the ones listed below (Florida DOE, 1996).

- Math: *uses and justifies different estimation strategies in a real-world problem situation and determines the reasonableness of results of calculations in a given problem situation.*
- Language Arts: *selects and uses strategies to understand words and text, and to make and confirm inferences from what is read, including interpreting diagrams, graphs, and statistical information.*

Dispositions and habits contribute to the success of thinking in developing valid outcomes for life situations. They include an individual's tendencies and behaviors to seek accuracy and clarity, restrain impulsivity, take a position or direction, exercise self-regulation, think critically and creatively, set goals, make and execute strategic plans, seek and evaluate reasons and justifications, analyze and monitor one's own thinking processes, sustain intellectual curiosity, organizing information and ideas, persisting when answers are not apparent, and remain open-minded in exploring alternative views and generating multiple options (Dewey, 1933; Fogarty & McTighe, 1993; Huot, 1998; Marzano, 1993; McREL, 1997).

In this model, cognitive strategies have been classified as simple thinking strategies. They *often intrinsically possess a simple structure* such as underlining main ideas, outlining, and paraphrasing (Gagné, Briggs & Wager, 1988, p. 70).

Connecting Networks and Operations

Bridges between interactive prerequisites and complex thinking skills related to life situations are formed by means of linkages, schemata, and scaffolding. They interweave the levels of thinking with content through *elaborating the given material, making inferences beyond what is explicitly presented, .building adequate representations, analyzing and constructing relationships* (Lewis & Smith, 1993, p. 133).

Different processes may create the connecting networks and operations to relate new conceptual meaning to previously established ones, to integrate new information into existing schemata, to restructure schemata, or to restructure experience (Ausubel, 1978; Dewey, 1933; Jonassen, 1996). Linkages from the connecting networks are critical because *in very simple terms, we remember those things for which we have made many linkages* (Marzano, 1993, p. 156).

Teaching strategies make a difference in learning outcomes (Underbakke, Borg & Peterson, 1993; Kauchak & Eggen, 1998; Merrill, Drake, Lacy, Pratt, & the ID2 Research Group, 1996). Methods of teaching also influence the type of learning outcomes. For example, a Socratic method, or the use of stories or case studies, or class discussions may produce different kinds of learning (Wilson, 1997, p. 11).

Teachers who provide ready-made rules and generalizations for students to memorize are following practices that interfere with the development of thinking skills (Glaser, 1941). Novelty and usefulness to real life, and tasks that are neither too easy nor too difficult, hold more promise for making goals meaningful than isolated, rote learning tasks. The synchronous development of thinking skills with a deepening of the knowledge base promotes higher levels of thinking (Cotton, 1997; Crowl et al, 1997; Weisberg, 1995). Cognitive development through layers of instruction,each elaborating on the previous levels, progressively moves the learner from simple to complex concepts and thinking processes (Reigeluth, 1987; Reigeluth cited in Wilson & Cole, 1992).

Thinking skills instruction produces gains on measures of learning and intelligence (28 studies cited in Cotton, 1997). This instruction includes multidimensional strategies, wait time after presenting questions or problems, and a variety of examples with think-aloud explanations. It may include cycles of analysis and a period of incubation or reflection (Crowl et al, 1997; Facione, Sanchez, Facione & Gainene, 1995; Pogrow, 1990; Pogrow & Buchanan, 1985). Practical methods for infusing thinking into curriculum and instruction include the ones listed below (APA, 1997; Dewey, 1933; Glaser, 1941; Huot, 1998; Kauchak & Eggen, 1998; Marzano et al, 1988; McREL, 1997).

- Encourage positive attitudes, perceptions, and motivation about learning in a supportive and safe learning environment with respectful and caring relationships.
- Emphasize acquisition of meaningful knowledge, especially procedural knowledge as a base for applied thinking.
- Link, extend, and deepen knowledge through thinking skills applied to relevant, authentic, real-life learning tasks.
- Use knowledge and skills in meaningful authentic tasks over a period of time.
- Develop dispositions, habits of mind, or habits of reflection for organizing information and thinking and learning processes, including creative and critical thinking.

In addition, it is important to provide the following.

- Alignment in content and complexity of tasks, assessment activities, and objectives (Kauchak & Eggen, 1998).
- Deliberate design of activities and programs to teach specific thinking and learning strategies along with self-monitoring, self-reflection, and evaluation (Cotton, 1997; Darmer, 1995, abstract; Easterwood, 1996, abstract; Glaser, 1941; Kauchak & Eggen, 1998; Perkins & Salomon, 1989).
- Directions on use of cognitive strategies such as methods of rehearsal, elaboration, organization, reflection, and paraphrasing to improve one's own learning (Cotton, 1997; Crowl et al, 1997).
- Novel problems and questions to evoke thinking (Dewey, 1933; Kauchak & Eggen, 1998).
- Emphasis of broad problem solving strategies, algorithms, or heuristics (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Clarity of instructions and assignments, e.g., explain the nature of the thinking task (Kauchak & Eggen, 1998).
- Organized activities and structure for processes (Kauchak & Eggen, 1998).
- Choices among assignments (Kauchak & Eggen, 1998; Crowl et al, 1997).
- Emphasis on transfer of skills to everyday life situations by including conditions of real-life in practice opportunities (Kasonen & Winne, 1995; Perkins & Salomon, 1989;.
- Scaffolding of just enough support to guide students until they can perform skills independently (organizing frameworks, hints, questions, examples with explanations, modeling, corrective and specific feedback) (Kauchak & Eggen, 1998; Slavin, 1995; Vygotsky in Crowl et al, 1997; McREL, 1997).
- Explanation and modeling of habits of thinking and dispositions such as persistence (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Activities that use various types of intelligences and encourage intellectual diversity (Gardner in Crowl, 1997; Gardner cited in Kauchak & Eggen,1998;Kauchak & Eggen, 1998; Merrill, 2000).
- Open-ended tasks involving several ways to resolve difficulties or solve problems and that give opportunities for small groups to contribute to outcomes (Kauchak & Eggen, 1998).
- Visual and verbal representations and explanations (drawings, graphs, maps, tales, hierarchies, lists of steps) (Clarke, 1990; Crowl et al, 1997; Glaser, 1941; Kauchak & Eggen, 1998).
- Practice in making inferences, in deciding how and when to apply different types of thinking skills, and in producing outcomes for a variety of life situations (Crowl et al, 1997; Howe & Warren, 1989; Kauchak & Eggen, 1998).
- Frequent, short assignments to include learning of prerequisite knowledge and skills and drill and practice using verbal analogies, logical reasoning, inductive and deductive thinking, and discrete steps and linkages involved in complex thinking processes (Kauchak & Eggen, 1998).
- Varieties of structured peer tutoring, cooperative learning, collaborative small group work, team assisted individualization with individual responsibilities and group products (Kauchak & Eggen, 1998; Kewley, 1996, abstract). [Social interaction is one of the vehicles by which learners share information (Vygotsky cited in Crowl et al, 1997)].
- Small group discussions only after assuring presence of prerequisite content knowledge and thinking skills (Kauchak & Eggen, 1998).
- Limited direct teaching, and if used, focus on mini-lectures combined with activities such as guided practice, demonstrations, debates, student questions, reviews and summaries (Patrick, 1986; Crowl et al, 1997; Kauchak & Eggen, 1998).
- Questioning strategies to stimulate curiosity of all learners, beginning with lower-order questions and progressively leading up to more complex questions (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Monitoring, feedback, redirection, and correction of inefficient or incorrect strategies and pursuit of dead-end or simplistic answers (Cotton, 1997; Crowl et al, 1997).

- Feedback in the form of informal checks, immediate, with positive emotional tones, specific and non judgmental, simple correction of errors without overexplaining (Crowl et al, 1997; Kauchak & Eggen, 1998).
- Reinforcement and encouragement of targeted thinking skills and progress of learners to develop their confidence and a greater sense of locus of control (Cotton, 1997; Crowl, 1997).
- Adaptations for diverse learner needs (Kauchak & Eggen, 1998).
- Mastery skills development and test management for subskills and prerequisite knowledge (Kauchak & Eggen, 1998).

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Social Desirability Responding on World Wide Web and Paper-Administered Surveys

Dawson R. Hancock
Claudia P. Flowers
University of North Carolina at Charlotte

Abstract

Social desirability responding (SDR) on surveys administered on the World Wide Web (WWW) and on paper was examined using 178 graduate and undergraduate students randomly assigned to a 2 (survey's administration mode: WWW and paper) × 2 (participants' identifiability level: anonymous and non-anonymous) true experimental design. The findings reveal no differences in SDR between the WWW and the paper-administered survey conditions, and no differences in SDR between the anonymous and non-anonymous conditions. These findings and potential explanations are examined for consideration by anyone interested in using the WWW to obtain accurate information from survey participants.

Introduction

Response bias (i.e., the systematic tendency to respond to surveys, questionnaires, standardized tests, and other self-report measures on some basis other than the specific item content) continues to confound research findings. People's reports of their own traits, attitudes, and behaviors often involve systematic bias that obscures measurement of content variables (Calsyn, 1999; Paulhus, 1991). For example, early research suggested that standard self-report methodologies distorted the reporting of racist attitudes (Sigall & Page, 1971), abnormal sexual attitudes (Knudson, Pope, & Irish, 1967), desirable behaviors (Phillips & Clancey, 1972), deviant behaviors (Clark & Tifft, 1966), and abortion (Wiseman, 1972). More recent studies have revealed a tendency among individuals to conceal truth when reporting unverifiable information (Lautenschlager & Flaherty, 1990), seeking employment (Calsyn & Klinkenberg, 1995), reporting information designed to impress others (Rosenfeld, Giacalone, & Riordan, 1995), and when a respondent's anonymity is violated (Sproull & Kiesler, 1991).

Among the most common forms of response bias reported in the literature are deviant responding (Berg, 1967), careless responding (Meehl & Hathaway, 1946), consistent responding (Dillehay & Jernigan, 1970), item omission (Cronbach, 1946), acquiescence (Ray, 1983), and extremity bias (Hamilton, 1968; Peabody, 1962). However, perhaps the most frequently studied response bias is *social desirability responding (SDR)* (i.e., the tendency to provide answers which cause the respondent to look good) (Rosenfeld, Booth-Kewley, Edwards, & Thomas, 1996). As early as the 1930s, Bernreuter (1933) reported that psychometricians had already noted the problem of SDR effects on the validity of questionnaires. Years later, Meehl and Hathaway (1946) were able to cite eight measures specifically designed to index SDR in self-report measures. Since that time, SDR has been a major concern in measuring personality, psychopathology, attitudes, and self-reports of various forms of sensitive behavior (Paulhus, 1991).

Recently, the proliferation of web-based and other computer-assisted means of acquiring information from individuals has raised concerns regarding how responses obtained through computers compare with responses obtained on paper instruments. Several published studies (see Booth-Kewley, Rosenfeld, & Edwards, 1993; Moorman & Podsakoff, 1992, for reviews) have reported that computer responses are more candid, less biased, and less influenced by social desirability than responses given on paper. However, very few studies have examined people's responses on the World Wide Web (WWW). Furthermore, several research efforts have failed to replicate the findings of previous studies regarding SDR. For example, studies in the 1980s investigating the feasibility of a U.S. Navy computer-based survey system failed to demonstrate that computer-administered surveys were superior at reducing SDR (Doherty & Thomas, 1986; Rosenfeld, Doherty, Vicino, Kantor, & Greaves, 1989; Vicino, 1989). In addition, Lautenschlager and Flaherty (1990) found that undergraduates responding to a computerized survey had higher scores on a self-deception scale than did their counterparts who used a paper survey. Extending this research, Booth-Kewley et al. (1993) had subjects complete surveys using computer or paper administration modes under anonymous or identified conditions. Consistent with Lautenschlager and Flaherty's (1990) results, Booth-Kewley and her colleagues found that identified respondents gave more socially desirable responses than did their

anonymous counterparts. However, Booth-Kewley et al. (1993) failed to replicate Lautenschlager and Flaherty's (1990) finding of greater levels of SDR among participants who completed the survey by computer.

The lack of consistent findings regarding the extent to which people demonstrate SDR on computer versus paper-administered instruments, combined with the scarcity of research in this area on people who respond to surveys and questionnaires administered through the WWW, was the purpose for conducting the current study. Based on previous research suggesting that computer-administered surveys yield more candid responses than do paper surveys, this study hypothesized that adult students taking a survey on the WWW would demonstrate significantly less SDR than would students taking the same survey on paper. Furthermore, based on previous research suggesting that participants would be more inclined to respond to survey items under conditions of anonymity, this study hypothesized that adult students taking the survey anonymously would demonstrate significantly less SDR than would respondents who were asked to identify themselves.

The Study

Participants

178 undergraduate and graduate students at a large university in the southeastern United States, enrolled in introductory research and technology courses, participated in this study. 69% of the participants were female. The average age of participants was 34.2 years.

Instrument

To assess the extent to which participants would demonstrate SDR, this study used the Balanced Inventory of Desirable Responding (BIDR) (Paulhus, 1993). The BIDR consists of 40 items stated as propositions. Respondents rate their agreement with each statement on a seven-point scale. The scoring key is balanced. After reversing the negatively keyed items, one point is added for each extreme response (six or seven). This method of scoring ensures that high scores are attained only by subjects who give exaggeratedly desirable responses. The 40 items are then summed to yield an individual's overall level of SDR.

Several studies have established the reliability and validity of the BIDR. With respect to internal validity, values of coefficient alpha have ranged from .68 to .80 and from .75 to .86 (Mellor, Conroy, & Masteller, 1986; Paulhus, 1984, 1993; Quinn, 1989). Demonstrating concurrent validity as a measure of SDR, the sum of the 40 items on the BIDR correlated .71 with the Marlowe-Crowne Social Desirability scale (Crowne & Marlowe, 1960) and .80 with the Multidimensional Social Desirability Inventory of Jacobson, Kellogg, Cauce, and Slavin (1977). Supporting the construct validity of the BIDR, Paulhus (1991) discovered that high deception subjects were more likely than lows to show a self-serving bias after a failure experience. High self-deception subjects also showed more illusion of control, belief that they were safe drivers, and proneness to love (Paulhus & Reid, 1991) and to intrinsic religiosity (Leak & Fish, 1989).

Procedures

Using a true experimental design, this study examined the impact of two independent variables -- the participants' identifiability level (i.e., anonymous and non-anonymous) and the survey's administration mode (i.e., WWW-administered and paper-administered) -- on one dependent variable -- the participants' social desirability response levels measured by the BIDR. Using a random number table, 283 potential participants were assigned randomly to one of four conditions: (a) anonymous/WWW-administered survey (n=75); (b) non-anonymous/WWW-administered survey (n=78); (c) anonymous/paper-administered survey (n=63); and (d) non-anonymous/paper-administered survey (n=67).

Prior to their departure from the classroom during an initial session in the course, participants in all four conditions were provided a manila envelope by their professor, who was instructed to say, *"Prior to our next class attendance, please follow the instructions contained in your envelope. Those instructions will require you to individually complete a very short survey that we will use later in this course when we discuss data collection techniques. Remember, please follow the instructions contained in your envelope by our next class attendance. Thank you."*

For the participants in the paper-administered survey groups, the manila envelopes contained a copy of the Balanced Inventory of Desirable Responding (BIDR). One-half of the BIDRs in those envelopes (i.e., the non-anonymous/paper-administered survey group) were preceded by the written instructions, *"Please complete the following survey and mail it in the self-addressed envelope prior to our next class attendance. The survey contains 40 items and takes approximately 10 minutes to complete. Using the scale below as a guide, write a number in each blank to indicate your agreement with the statement. For the purpose of accountability, please be certain that you*

print your name legibly in the blank provided. The results of this survey will be completely confidential. The results will be reported only in the aggregate; therefore, at no time will you be identified individually."

The other one-half of the BIDRs in those envelopes (i.e., the anonymous/paper-administered survey group) were preceded by the same written instructions, with one exception -- the phrase, *"For the purpose of accountability, please be certain that you print your name legibly in the blank provided,"* was replaced with the phrase, *"To maintain anonymity, please do not indicate your name anywhere on the survey."*

For the participants in the WWW-administered survey groups, one-half of the manila envelopes (i.e., the non-anonymous/WWW-administered survey group) contained a sheet of paper with the written instructions, *"Please complete the survey that you will find on the World Wide Web at http://education.uncc.edu/survey1.htm prior to the next class attendance. The results of this survey will be completely confidential. The results will be reported only in the aggregate; therefore, at no time will you be identified individually."* For participants in this condition, the BIDR at the prescribed web site address included the following additional instructions, *"This survey contains 40 items and takes approximately 10 minutes to complete. Using the scale below as a guide, type a number in each blank to indicate your agreement with the statement. For the purpose of accountability, please be certain that you type your name in the blank provided."*

The other one-half of these manila envelopes (i.e., the anonymous/WWW-administered survey group) contained a sheet of paper with the same written instructions, with two exceptions -- the WWW address for accessing the survey for participants in this condition was changed from *"education.uncc.edu/survey1.htm"* to *"education.uncc.edu/ respond1.htm,"* and the phrase, *"For the purpose of accountability, please be certain that you type your name in the blank provided,"* was replaced with the phrase, *"To maintain anonymity, please do not indicate your name anywhere on the survey."*

Of the 283 potential participants in this study, 181 students completed a survey (i.e., a 64% response rate). However, three students' survey responses were excluded from the data analysis because these students incorrectly completed the survey. Of the remaining 178 surveys, 44 surveys were in the anonymous/World Wide Web-administered condition (i.e., a 59% response rate), 50 surveys were in the non-anonymous/World Wide Web-administered condition (i.e., a 64% response rate), 44 surveys were in the anonymous/paper-administered condition (i.e., a 70% response rate), and 40 surveys were in the non-anonymous/paper-administered condition (i.e., a 60% response rate).

A 2x2 analysis of variance (ANOVA) was conducted with the survey's administration mode (i.e., WWW-administered and paper-administered) and the participants' identifiability level (i.e., anonymous and non-anonymous) as the independent variables and the participants' SDR levels measured by the BIDR as the dependent variable.

Findings

Means, standard deviations, and sample sizes for the social desirability levels by condition are presented in Table 1. The results of the ANOVA are presented in Table 2. The main effect for survey administration mode was not statistically significant ($F(1,174)=.071$, $p>.05$). Students taking the survey on the WWW ($M=15.33$, $sd=6.23$) did not demonstrate significantly less SDR than did adult students taking the same survey on paper ($M=15.07$, $sd=5.50$). Furthermore, the main effect for participants' identifiability level was not statistically significant ($F(1,174)=.150$, $p>.05$). Students taking the survey anonymously ($M=15.03$, $sd=5.47$) did not demonstrate significantly less SDR than did survey-takers who were asked to identify themselves ($M=15.39$, $sd=6.29$). Finally, there was no statistically significant interaction ($F(1,174)=.027$, $p>.05$), suggesting that no differential effect on SDR was noted with the combination of independent variables.

Conclusions

The hypotheses of this study were based on previous research; therefore, it is important to examine possible reasons for the non-statistically significant findings. One explanation may be that, unlike the current study, most previous studies linking lower anonymity with higher levels of SDR administered their surveys within the context of the experimental setting. For example, Lautenschlager and Flaherty (1990) asked college students to complete the BIDR in a small office on the site of the study. Similarly, Rosenfeld, Booth-Kewley, Edwards, and Thomas (1996) administered the BIDR to Navy recruits in a large testing room immediately after the sailors received instructions about the study. However, in the current study, after the professor distributed the manila folders, students were allowed to depart the classroom with the expectation that they would complete the survey on the WWW or paper prior to the next lesson. Undoubtedly, students completed the survey in many different locations -- at home, at work, at school, in a computer lab, and so forth. As a result, even those students in the non-anonymous WWW and paper-administered survey conditions whose instructions included a directive to type or print their names on the

survey may have felt a sense of anonymity as they completed the BIDR. This pervasive sense of anonymity experienced by the participants may have mitigated the effects of self-identification created in the study, thereby contributing to the lack of a statistically significant main effect for participants' identifiability level.

Another potential contributor to this study's findings may have been the written instructions provided to the participants. In all experimental conditions, the written instructions included the sentences, *"The results of this survey will be completely confidential. The results will be reported only in the aggregate; therefore, at no time will you be identified individually."* Although these sentences were inserted to ensure compliance with the 1974 Buckley Amendment, their inclusion may have lessened the extent to which participants in the non-anonymous conditions perceived that they could be identified. In effect, these sentences may have caused all participants to believe that their identity was completely protected, thereby mollifying the impact of anonymity on participants' demonstration of SDR.

Furthermore, research has suggested that a survey-taker's perception of the verifiability of her or his survey responses may impact the extent to which the survey-taker stretches the truth in an effort to make a good impression (Lautenschlager & Flaherty, 1990). Specifically, when respondents believe that their answers cannot be validated, they tend to exhibit higher levels of SDR than when they think that their responses are verifiable. In the current study, however, participants were told that the results of the survey would be used in an upcoming discussion of data collection techniques. As a result, participants may have believed that the survey responses were being verified, thereby negating any SDR effects prompted by the method of survey administration (i.e., WWW or paper).

In the past, one factor often associated with lower levels of SDR in computer-administered survey responses than in paper-administered survey responses has been the standardization that computer administration affords (Feuer, 1986). In computer-administered surveys, SDR may be reduced by controlling the respondent's ability to preview, skip, review items, and change responses. In other words, the greater structure imposed by the computer mode of survey administration may limit respondents' ability to reveal themselves in the best possible light. However, in the current study, the survey's presentation on the WWW was designed to maximize participants' freedom to negotiate the instrument. Students who accessed the BIDR through the WWW had complete latitude to preview, skip, change, and review their responses to the items prior to submitting their surveys electronically. As a result, the restrictions often inherent in computer survey administration which lead to lower levels of SDR were not evident in this study, perhaps contributing to the non-statistically significant main effect for survey administration mode.

Finally, although early research revealed that computer-administered survey settings seemed to reduce SDR because those settings offered greater anonymity and were perceived as impersonal and nonjudgmental, recent studies have discovered a growing concern among many survey-takers that computers are becoming overly intrusive (Rosenfeld, Booth-Kewley, Edwards, & Thomas, 1996). This concern, sometimes labeled the 'big brother syndrome" (Martin & Nagao, 1989), suggests that people are becoming more aware that computer communications can be monitored and shared. Computer-users who suspect "big brother monitoring" have reported increased anxiety, fatigue, stress, and reduced job satisfaction (Eisman, 1991; Iadipaolo, 1992). In the current study, students in the computer-administered survey condition may have felt that their responses, even in the anonymous condition, could and perhaps would be traced to them through the WWW. As a result, participants may have felt less inclined to present themselves in a truthful manner.

The growing popularity of computers throughout much of the world suggests that computer administration of surveys will continue to increase in the future. Therefore, it is important to know how survey responses obtained through computers compare with responses obtained on paper instruments. Although some research has reported that computer responses are more candid, less biased, and less influenced by social desirability than responses provided on paper, the current study using the WWW as the means by which to administer computer-based surveys did not support these findings. Students taking a survey on the WWW did not demonstrate significantly less SDR than did students taking the same survey on paper, and students taking a survey anonymously did not demonstrate significantly less SDR than did survey-takers who are asked to identify themselves. Unlike traditional computer-based modes of survey administration in which people demonstrate less SDR than people taking a survey by paper, this study suggests that people who take surveys on the WWW demonstrate SDR at levels comparable to those who take paper surveys. Although increased objectivity and cost effectiveness have often been associated with computer administration of surveys relative to paper administration of surveys, this study's findings should be considered carefully by all professions interested in using the WWW to obtain truthful and accurate information from survey-takers.

Table 1

Means, Standard Deviations, and Sample Sizes of Social Desirability Responding Level by Participants' Identifiability Level and Survey's Administration Mode

	Administration Mode								
	World Wide Web-Administered			Paper-Administered			Overall		
Participants' Identifiability	M	SD	n	M	SD	n	M	SD	n
Anonymous	15.07	5.73	44	14.98	5.25	44	15.03	5.47	88
Non-anonymous	15.56	6.69	50	15.18	5.83	40	15.39	6.29	90
Overall	15.33	6.23	94	15.07	5.50	84	15.21	5.88	178

Table 2

2x2 ANOVA of Effects of Participants' Identifiability Level and Survey's Administration Mode on Social Desirability Responding Level

	SS	df	MS	F	Sig
Participants' Identifiability Level (PIL)	5.256	1	5.256	.150	.699
Survey's Administration Mode (SAM)	2.504	1	2.504	.071	.790
PIL x SAM	.956	1	.956	.027	.869
Residual	6115.868	174	35.149		

Note: $p > .05$

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Student Perceptions: Printing Activities' Influence On Satisfaction with Web-Based Instruction

Karen Kaminski
Colorado State University

Landra L. Rezabek
University of Wyoming

Abstract

The use of Web-based and Web-enhanced instruction is growing rapidly. There is much information and discussion surrounding the layout of content on the screen and facilitating communication yet little information is available regarding the students perception and use of online instruction. Everyone knows that students print information available on the Web but not why nor how this affects their satisfaction with the course. This study was designed to identify factors that influence students to print course information delivered online, to ascertain if these printing activities are related to reducing barriers, and to determine if these printing activities influence students' satisfaction for learning via the Web. Implications for the design and development of Web-based instruction are discussed.

Designers and developers of Web-based instruction, specifically Web-enhanced instruction, assume that students use the information in the format it was designed that is, online. If fact, many learners actually transfer this information to paper by printing it. This study was designed to identify factors that influence students to print course information delivered online, to ascertain if these printing activities were related to reducing barriers, and to determine if these printing activities influence students' satisfaction for learning via the Web. These possibilities have implications for the design of Web-based instruction.

As interest in Web-based instruction (WBI) has grown, much of the discussion in professional circles has revolved around the mechanics of which software to use (McCollum, 1997); how and when to incorporate visuals (Bixler & Spotts, 1998; Dana, 1998; Milheim & Rezabek, 1997); and how to manage e-mail, listserv and threaded discussions (Friedlander & Kerns, 1998). In addition to spending time on the mechanics of Web page development, a considerable amount of the WBI designer's time is devoted to the design and layout of the screen or interface (Bixler & Spotts, 1999; Carr & Peters, 1998; Horton & Lynch, 1998; Ipek, 1999; Kahn, 1999; McCormack & Jones, 1998; Montgomery, 1998). Finally, current research has focused on online communication issues such as email, bulletin boards, and threaded discussions (Jiang, 1998; McCabe, 1997; Nasseh, 1996). These discussions do not address the aspects of evaluating learning opportunities via the Web, nor do they address concerns arising when students transfer information from the computer screen to the printed page.

The systematic approach to the design of instruction (Dick & Carey, 1990; Gagne, Briggs & Wager, 1992; Reigeluth, 1999; Seels & Glasgow, 1997; Smith & Ragan, 1993) suggests that the analysis of student characteristics is critical to the design of effective instruction. There is little research available which tells the instructional designer, course developer, or instructor, how students are actually using online course materials. Ward (1998) found that many articles have been published on instructional design issues, technical considerations, and accreditation issues of distance education courses but little has been published regarding the online distance learner's experience in his or her own words. Determining the form in which students prefer to use information, and what their learning needs are is a crucial design component for designers of WBI.

Instructional Design and the Web-based Instructor

The design of effective instructional materials is a complex task. The designer asks what is the message being delivered to the learner and what is the best way to deliver that message. With the advent of Web-based instruction, an entire new set of concerns is presented to the instructional developer. These include questions such as how to break the information up into usable pieces and how to guide the student through the now nonlinear information. At first, screen layout and design were based on well-established theories of layout for the printed page.

From the beginning of their educational experience, students learn to learn from the printed page. Researchers have had years of opportunity to study this method of information delivery. As Houle (1996) notes for print based information, much is known about such matters as readability, the display of exhibited material, the way

potential for further follow-up as there was no way to determine which students in a class had not responded and to then contact them individually.

As responses were submitted by the participants the multiple-choice questions were tallied automatically by the WebCT program. The researcher compiled the short answer and paragraph responses for further analysis. The qualitative questions were coded based on similar and related themes of response.

Underlying Assumption

The assumption was made that students do print the information made available on a course Web site. One hundred seventy-five participants (85.37%) reported they printed pages from the course Web site. This number substantiates the assumption. Eighty-two participants (40%) reported they printed 50 or more pages from the course Web site. The average number of pages printed was approximately 30 (mean = 4.79, SD = 2.30).

Factors that Influence Students to Print

The primary research question determined factors that influenced students to print online course information.

Computer Access

Requiring students to access a computer to obtain course materials or participate in discussion forced them to be in a particular location, at the computer. The majority of participants used a computer at home (n = 148, 72.20%) or a computer in a lab on campus (n = 143, 69.76%). Twenty-two of the participants (10.73%) indicated they used a computer at work and 42 of the participants (20.49%) indicated they used a computer in other locations. Eighty of the participants (39.24%) used a computer both in a lab on campus and at home. It is important to note that analysis of the data in this study indicated that the actual location of the computer, for example at home or in a computer lab, did not affect student satisfaction with the course, students' perception that printing affected satisfaction with the course, or the number of pages printed.

Reasons for not Printing

The primary reason for not printing, reported by 12 participants (5.80%), was to save paper. The next most frequently reported reason, reported by 8 participants (3.90%), was that there were too many pages to print and it took too long. Although 19 participants who did not print provided reasons related to cost, (too many pages, to save paper, and don't own a printer) cost did not appear to be a major factor in this study.

Reasons for Printing

The data indicate that course information on the Web was not accessible during class, was not transportable, was not easy to reference, and was not tangible. The most common reason for printing, (n=71, 40.57%) was that participants printed the information to study. This was followed by; to be able to take the information with them to other locations (n=46, 26.29%), for easy reference to the materials (n=43, 24.57%), to be able to take notes on the pages, highlight them, and use them during lecture (n=36, 20.56%), and it is hard to read on the computer (n=18, 10.29%).

Each of these reasons for printing could be interpreted as a more specific indication of using the materials to study. They each support the literature indicating that location is a barrier. These reported reasons for printing also support the literature that students return the information to a format in which they are familiar (Pantel, 1997; Ruben, 1996) that is: to be able to carry the information with them as they do text books, handouts and notes; to be able to access the information in class, between class, and in multiple locations; and to be able to write on the information.

Learner Investment in Time on Course and Printing

The average time students invested in the course was 4.67 hours (SD = 3.96). The average time students invested in printing was 20 minutes (SD = 25.94). The average time students spent printing was 4% of the average total time they reported spending on the course. In addition, only three participants indicated the time it took to print as a reason not to print. Therefore the time it takes to print out online class information did not appear to be a major factor in this study.

Prior Experience

It could be expected that the more prior online course experience, the fewer pages printed. It does not appear that prior experience in learning via WBI or Web-enhanced instruction has an affect on the printing activities of students that participated in the study. Ninety-nine participants (48%) reported that this was the first course they had taken that had a Web component (mean = 1.96, SD = 1.09). Thirty-nine participants (19.02%) reported they had taken one prior course with a Web component and the same number reported two prior courses. Twenty-five participants (12.20%) indicated they had completed three or more courses with Web components.

Based on the number of pages printed by the students, further analysis was needed to determine if this printing activity was related to lack of experience with learning online. Using Spearman's Rho indicated that there is a low, positive relationship between number of prior courses and the number of pages printed (r = .130). This result indicated students with more prior experience in courses with a Web component printed as much as or slightly more than students with little or no prior experience. Therefore designers of WBI can not assume that students will get use to using course materials online and will not want or need to print them.

Influence on Satisfaction

The second research question determined if students' printing activity affected their satisfaction with the course.

Difficulty Using the Information on the Course Web Site and in Print

The majority of the participants (84.88%) indicated that it was moderately easy or very easy to use the information on the Web site (mean = 3.26, SD = .803). Of those who did print from the Web site, 90.62% reported it was moderately or very easy to use the information they printed (mean = 3.20, SD = 1.01). When asked what dificulties student has with printed information, fifty-one of the participants did not respond to this question, 44 participants stated that they did not have difficulties, and 18 reported that the question was not applicable. The reported difficulties were related to the format of the information to be printed. Examples included graphics that would not print or were not legible if they did print and that the format of the information printed was ruined making it difficult to find information.

Satisfaction with the Overall Course

Of the students who participated in this study 82 or 40% reported they were mildly satisfied with the course and 41 or 20% reported they were very satisfied with the course (mean = 2.60, SD = 1.04). Thirty-five percent of the participants indicated that their printing activity mildly increased their satisfaction with the course and 19% indicated that their printing activity greatly increased their satisfaction with the course (mean 3.63, SD = .996).

Printing and Its Affect on Satisfaction

Spearman's Rho was used to determine the relationship between overall satisfaction with the course and students' perception that printing affected satisfaction with the course (r = .334). This moderately positive relationship suggests that the more students believed that printing increased their satisfaction with the course, the more they perceived that they were satisfied with the overall course. To further examine how students' printing was related to course satisfaction, Spearman's Rho was used to determine the relationship between the number of pages printed and perception that printing affected satisfaction for the course (r = .304). The results indicated that the number of pages printed has a low, positive relationship to the affect that printing had on student satisfaction for the course. Namely, the more pages participants printed, the more they reported an increase in satisfaction in the course. The increase in satisfaction based on printing may have been due to the students' ability to use the information they printed in the same fashion that they would use traditional class materials.

Finally, analysis of the data showed that satisfaction for the course and students' perception that printing activities influence satisfaction were not related to where students reported they had access to a computer for the course. In addition, the number of pages printed was not related to location of a computer. In other words whether a student used a computer at home or in a campus lab for course work did not affect their perception of course satisfaction, printing activity, or the number of pages they printed.

Preference for Receiving Learning Materials

This finding was also reflected in the participants' response to their preference for receiving the materials. Fifty-nine participants (28.78%) reported that they would prefer the option to purchase a preprinted packet. Forty-nine participants (23.90%) reported that they would prefer to have a version online that is formatted for print. Fifty-

two participants (25.27%) reported they preferred to print from the screen. Thirty-three of the participants (16.10%) reported that they preferred to use the information online.

Suggestions for Designers and Developers of WBI

The recommendations reported followed three themes. The first theme was to support the students in their printing activities. This theme included recommendations such as formatting the information for print, breaking the information up into printable chunks, and providing printing options without graphics and color. The second theme was related to the actual instruction. This theme included recommendations such as instructors still needed to show enthusiasm for teaching and enhancing communication. The third theme was related to the design of the course Web site. This theme included recommendations such as providing a study guide for the Web, making the Web site more interactive, and ensuring the information on the Web was accurate.

Some of the student responses did not apply to the Web-based aspects of courses but did provide information about the attitudes and beliefs of the learners who participated in the study. Several students commented that WBI was a positive approach to learning. "Online courses have been a blessing and are absolutely a great way to take a class." "After I got used to using the web site I really enjoyed having the freedom of when to get my work done." Others expressed a very different attitude: "Taking quizzes online is fine, but learning online is not." "Please stop making Internet classes, they are just another fabrication of this increasingly impersonal world and is seemingly a waste of time." "I think that having the entire class online really took away from my learning experience and I am upset for having to pay for such a format." "Personally, I prefer to obtain written notes in a classroom format because I think that the instructor and students interaction is very important to really learn the material."

The Web is an efficient way to distribute information to students quickly and is inexpensive for the faculty/institution. Instructors and designers need to be aware of the students' perceptions of learning online and take students' concerns into consideration when developing WBI.

Implications for Design and Development of WBI

The information obtained in the study presents a number of implications for the design of WBI. These implications support the instructional design principles presented in the literature of knowing the audience and designing effective instructional materials to meet the learners' needs and preferences (Dick & Carey, 1990; Gagne, Briggs & Wager, 1992; Reigeluth, 1999; Seels & Glasgow, 1997; Smith and Ragan, 1993).

First, instructional design models indicate it is important to do as complete an analysis as possible of the audience that will be using the course Web site. This can be done by surveying students in a traditional offering of the class or in a class that is similar to or a prerequisite for the class being designed for the Web. If the students are going to print the information on the Web site to facilitate their learning, then content should be provided in a printable format. As a number of students indicated in their recommendations, they want to be able to print the information without color or graphics.

Secondly, designers should look more closely at the information they are putting online. During the phase of media selection, designers need to determine if the information simply replaces another medium or if it supplements information presented in another form. Not all educational experiences are appropriate for online technologies (Druin & Solomon, 1996; Volker & Simonson, 1995). Questions for the designer to investigate include: Is the information interactive, providing feedback for the learner? Does the information present some form of visual communication or motion that can not be presented on a black and white sheet of paper? Can the students easily access the information they need to complete assignments and study? Answers to these questions influence decisions to place course information online, to offer it in a printable version or to offer it in another form.

Thirdly, the designer needs to consider all the instructional resources available. Students did not express dissatisfaction with printing information from the course Web site. If the textual information is to be printed, then both course designers and students can save much time and energy if resources are not used to format for the screen and make text information look appealing on a computer. Instead, designers can spend valuable time and resources developing instructional activities that use the interactive and visual features of the Web. Course information that is typically printed can easily be placed on the course Web site in a printable format. This activity supports Knox's (1980) belief that alternative materials that differ in emphasis and complexity result in program flexibility and responsiveness to learners. This allows participants the option to select materials that are relevant and challenging to them, set their own pace, and maintain interest through variety. Students can use this information to enhance their learning.

Finally, the designer of WBI needs to provide information on how the Web site should be used. Pantel (1997) suggests that when the size of the nonlinear information space is unknown it can be problematic. He recommends including a site map that provides guidance for the user. Although this information was not solicited, five students made the recommendation to provide instructions for printing and three students recommended providing a study guide for the course Web site.

Recommendations for Future Studies

Many institutions of higher education believe that delivering course content on the Web is one way they will remain competitive in the educational market. Much pressure is being placed on faculty to incorporate the Web into their teaching and learning. More research is needed to determine optimum design standards for developing Web courses that enhance student learning.

This study provides support for the anecdotal evidence indicating that students print information available on a course Web site. It also suggests reasons why the students are printing. Additional research is needed to gain more specific information regarding how students use the information they print from the Web site. The primary reason reported for printing was 'to study'. This raises the question of what it means when a student says 'to study'. An investigation of the literature on how students study is warranted.

Additional research is also needed to determine if satisfaction with online learning is affected differently when the course Web site is used in combination with other course materials as in a Web-enhanced course versus a completely Web delivered course.

Finally, additional research is needed to determine if courses with Web sites which are designed to be highly interactive provide different results than those courses with Web sites which simply provide content in the form of text and graphics. Specifically, does the increased online interaction affect students' satisfaction with the course and is this affect based on the interaction or on the fact that increased online interaction would require the students to spend more time at a computer to participate in class.

Summary

Pantel (1997) states it simply when he says that one significant advantage of the Web is that it causes us to expand the notion of a document by enabling multimedia documents. Whereas print is better at presenting text, photography better at presenting images, radio better at presenting sound, and television better at presenting video, the Web's advantage is that it combines all of these media reasonably well into a single package.

When students reach post-secondary education, they have spent most of their lives devising and hopefully perfecting an effective way to learn the material presented in their classes. When faculty place their course material on the Web, they are presenting the students with a new challenge in learning. Students can learn the mechanics of accessing a Web site and navigating through it. However, it takes time to develop new study habits.

"Learning as a process (rather than an end product) focuses on what happens when the learning takes place" (Merriam & Caffarella, p. 124). If the information is to remain online, then students will need to gain new tools in how to use the information effectively while it remains online. This requires a change in students study habits. They will need new techniques to replace taking notes on the printed pages and highlighting the important information. Until new study habits are developed, or students have the ability to take notes on the Web, to highlight online, and to access the Web remotely with pocket size computers the implication for the design and development of WBI include formatting the information in a way that facilitates learning. Students' printing activity is an important consideration for the design and development of Web-based instruction.

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The questions.

1. What is the name of your course? ____
2. What is your birth date? ______________________________
3. Please indicate your gender.
    ____male
    ____female
4. Please indicate your ethnic origin.
    _____ Asian
    _____ Black, non-Hispanic
    _____ Hispanic
    _____ American Indian
    _____ White, non-Hispanic
5. Where do you have access to a computer to access the course materials? Select all that apply.
    ___ I use a computer with Internet access at home.
    ___ I use a computer with Internet access at work.
    ___ I use a computer with Internet access in a lab on campus.
    ___ Other: public library, friend, etc.
6. Are you an undergraduate or graduate student?
    _____ undergraduate
    _____ graduate
    _____ other
7. In addition to participating in class through the class Web site do you meet face-to-face with your instructor in a classroom setting.
    _____ yes
    _____ no
8. Do you print out pages from the course Web site?
    ___ yes
    ___ no
9. If you do not print out pages from the Web site, what are the reasons why?
10. How many pages did/do you print out from the course Web site?
    0-5
    6-10
    11-20
    21-30
    31-40
    41-50
    more than 50
11. What type of information was available on the course Web site? Check all that apply.
    ___ Syllabus
    ___ Course schedule or calendar
    ___ Online discussion content
    ___ Assignments
    ___ Content

12. What other type of information was available on the course Web site?

13. What type of information was on the pages you printed? Check all that apply.
    ___ Syllabus
    ___ Course schedule or calendar
    ___ Online discussion content
    ___ Assignments
    ___ Content
14. What other information available on the course Web site did your print?
15. Why did you print the information on the course Web site?
16. On average, how much time do you spend working on this course each week?
17. On average, how much of the time that you spend working on this course is spent printing from the Web site?
18. Do you find it easy or difficult to use the course information on the course Web site?
    ___ Very difficult
    ___ Moderately difficult
    ___ Moderately easy
    ___ Very easy
19. Do you find it easy or difficult to use the course information you print from the Web site?
    ___ Very difficult
    ___ Moderately difficult
    ___ Moderately easy
    ___ Very easy
20. If you do have difficulties using the information you printed, what are they?
21. Indicate your overall satisfaction with this course.
    ___ very unsatisfied
    ___ mildly unsatisfied
    ___mildly satisfied
    ___ very satisfied
22. Does printing the Web pages increase or decrease your satisfaction for the course?
    ___ greatly decrease
    ___ mildly decrease
    ___ no affect
    ___ mildly increase
    ___ greatly increase
23. Indicate the number of courses, that require you to access a course Web site, you have completed prior to taking your current course.
    ___ 0
    ___ 1
    ___ 2
    ___ 3 or more
24. Given the following options, which would your prefer:
    ____ To purchase a printed packet of course information from a bookstore or similar location?
    ____ To print a version of the information formatted for the printed page.
    ____ To print the screens as they appear on the Web site.
    ____ To use the information online and not print.
25. Do you have recommendations for designers and instructors of online course information regarding your experiences

The Relationship Between the Types of Resources Used in Science Classrooms and Middle School Students' Interests in Science Careers: An Exploratory Analysis

Tiffany A. Koszalka
Pennsylvania State University

Abstract

The U.S. is investing millions of dollars each year on developing new resources to inspire students to pursue science careers, yet there are no data to support the premise that specific types of resources are associated with student interest in science careers. The results of this thesis demonstrated that using resources high in sociableness and high in webnicity positively and significantly related to higher levels of interest in pursuing science careers.

Introduction

Implications for future applications of technology are many ... a mature profession recognizes its needs and seeks to utilize all of the resources – human and nonhuman – that it can muster to attain its goals and objectives ... (Hayden & Torkelson 1973, p. 34).

The U.S. invests millions of dollars each year on securing and developing new resources to inspire students to pursue science. Since middle school is a time when students begin to explore careers - and select and de-select career domains to pursue (Gottfredson, 1981) - it is important to understand the relationships among the types of resources used during middle school science and the level of student interest in science careers.

There are indications from previous research that different sources of information may influence a student's choice to pursue science (Charron, 1991, Jovanovic & Steinbach King, 1998; Lederman & Druger, 1985). However, many questions remain unanswered in regard to the use of different types resources in the classroom. Is using information from outside the classroom – through human and web resources – during science more predictive of students' interest in science careers than students in classrooms that do not regularly employ these types of resources? Is using human or web resources during science class predictive of boys' science career interest … of girls'? To find answers to these questions data was collected on the different types of resources used in the classroom as well as gender, a factor that has been empirically shown to be related to the development of career interests (Hill et al., 1990; Hyde, 1993).

Learning and Information Resources

Career interests are *learned* characteristics (Super, 1984). Instructional designers and educators have an obligation to create environments that facilitate learning. A key step in the instructional design process is developing or integrating existing resources that will provide students with the information necessary to advance their learning process. Not much is really known about the relationship between learners and the use of different types of information resources employed in the classroom. Decisions about resources are rarely made based on understanding the relationships between learner-level and classroom-level factors, but often are based on best guesses, experience, the types of resources that are available, or the latest and greatest resource.

Dimensions of Informational Resources

In this study the types of supporting classroom resources were classified along two dimensions - "sociableness" and "webnicity" of information. On the first dimension, "sociableness," a resource is defined on its measure of providing information through interactions with people (Sundar, 1994). High sociableness occurs when people, human resources, are actively and socially involved in sharing information with others in the learning environment. Books, models, pictures, posters, or other objects are considered resources low in sociableness. Guests, experts, and others who participate with students during science instruction are high in sociableness. On the second dimension, "webnicity" (Grabowski, personal conversation on October 19, 1999) is a measure of a resource's interconnectedness of information to other supporting information on a continuum regardless of delivery methods or reference to the form of information. For this study, on one extreme, high webnicity refers to resources providing

vast and easily accessible supportive information as only available on the Internet. On the other extreme, low webnicity refers to resources that provide limited supporting information that is not easily accessed in time, often classroom-bound, i.e., requiring students to leave the classroom to get additional information, such as books, posters, and non-networked computers. Thus, different types of resources provide different types of information to students. Much of the literature indicates that exposure to both social and non-social information is important in developing career interests.

Why is Studying Student Interest in Science Careers Important?

Since the 1950's, following the Russian orbiting of Sputnik, the need for advances in science education has been a concern of educators, parents, employers, government agencies, and the American society at large. The government undertook actions to increase the scientific literacy and interest of America's students by developing new science and math curricula, educational resources, and more recently expending enormous capital to supply all classrooms with computer and Internet technology. This movement spawned many research efforts to measure the effects of these actions on students' pursuit of science and engineering majors. While the importance of well-prepared curricula to help educate students for these future needs is recognized by many, previous studies have not investigate whether the characteristics of the classroom, classroom resources, or of the students themselves were related more strongly to the development of interest in pursuing science-related careers.

Discovering the relationships among classroom-level and student-level characteristics and science career interests may help instructional designers and educators design educational environments using resources that empirically have been shown to be predictive of the development of student interests in pursuing science-related careers. These designs would then, in turn, support the efforts to increase student interest in science careers in the United States.

Development of Interest: Interactions and Relationship Building

Interest, an acquired attention or enthusiasm for a particular field, is a *learned* characteristic and has been shown to be the key factor in making career choices (Super, 1984). Developing interest in a specific career domain, such as science, is a consequence of many learning interactions with the people, information, and objects of the practice. Lave & Wenger (1991) describe learning, such as developing an interest in pursuing science, not as a matter of a person's internalizing knowledge but as a matter of a person's transforming his/her participation in a social community. Learning, therefore, is based on building relationships between people and their places in the community and associations with the information and objects of the practice. Thus, becoming a member of a community of scientific practice requires that newcomers interact with the information, artifacts, and people that make up and define the scientific community.

The development of career interests is a complex phenomenon. Much of the research provides evidence that there are specific background variables a person's life that also influence the development of specific career interests. When children enter into the early stages of adolescence and begin to explore relationships and activities outside the family they begin to develop independent career interests. Interactions with reference or peers groups, personality characteristics, societal expectations, perceived abilities, achievement levels, and acquaintances with role models outside the classroom all have been found to have some effect on the career aspirations of adolescents (Hill, Pettus, & Hedin, 1990).

Development of career interest and classroom variables

When children enter into adolescence and begin to develop their own career interests, people and activities outside the home and specifically in the classroom, influence them. Over the last two decades, much research has focused on investigating the relationship between rich learning environments and developing interest in science careers, especially for girls and minorities (Hill, Pettus, & Hedin, 1990; Kahle, Matyas, & Cho, 1985; Mason & Kahle, 1988). However, the research in this area has clearly focused on the results of sensitizing teachers to the needs of minorities and training teachers in the use of sound instructional strategies. No published literature could be found that reported on investigations of the relationships between the use of classroom resources and student science career interests in typical science classrooms as opposed to classrooms participating in science intensive programs.

Most theoretical perspectives also acknowledged the interactive effects of multiple variables, such as resources, instructional strategies, and gender, on student learning. However, a majority of the educational research neglects to take into account the influence of these variables on developing middle school students' interest in pursuing science. Nor could published research be found that specifically examined the predictive relationship

between the use of different types of informational resources in science classrooms and student interest in pursuing science-related careers.

Social Environment of the Classroom

A body of empirical research describing the relationship between psychological-social aspects of the classroom and students' interest in science is growing. Evidence exists to support the claim that, on average, students in classrooms with strong social environmental characteristics, such as high involvement, peer affiliation, and competition, do manifest more positive attitudes toward science than do students in classroom with low measures of these social characteristics (Fouts & Myers, 1992; Gallagher, 1994; Kahle, Matyas, & Cho, 1985; Talton & Simpson, 1987; Yager & Yager, 1985). However, Roth (1996) found that the diffusion of the various forms of knowledge occurred at different rates and in different forms in early adolescent student groups. Roth suggested that availability of specific resources and social networking that occurred during the classroom activities influenced student learning. It was unclear if learning was related more strongly to the webnicity or the sociableness of the supporting resources.

Why would Sociableness of Resources make a Difference?

Lent et al. (1994) argued that over the course of adolescence, being exposed to social interactions differentially reinforced the individual for pursuing certain activities from among those that were possible, thus gave rise to interests in specific career domains. Short-term social interactions and relationships with resources high in sociableness such as adults outside the family have the potential to cause changes in an adolescent's interests. These types of relationships do not generally yield emotionally laden feedback, as one would expect from family or close peers, but the feedback is perceived more as providing a valid evaluation of the adolescent's behavior (Darling, Hamilton, & Niego, 1994). Thus, an adolescent's self image can be influenced by resources high in sociableness such as a significant other outside the family because the adolescent believes that the other is a credible source of information about his/her behaviors. Exposing early adolescents to a variety of human resources during science class could be most beneficial in fostering curiosity and exploratory behaviors that promote career interests (Super, 1984).

Why would Webnicity of Resources make a Difference?

The interconnected nature of the Internet is making access to more information and more people much easier in the classroom. The types and numbers of resources that can be used in the classroom are increasing as schools become wired and access to the Internet expands. Studies have found that when web resources were introduced into the classroom, students interacted in more complex tasks, developed greater technical skills, and used more outside information (Hardin & Ziebarth, 1995; Owston, 1997; Rice, McBride, & John, 1998) than before the Internet was available. Thus, resources high in webnicity provided access to additional information resources and promoted the use of additional resources.

Web resources also provide connections to people outside the classroom. Research in this area reports that collaborative instructional strategies employing web resources high in sociableness and encouraging group sharing and knowledge development increased student achievement, perceptions, and self-esteem (Conlon, 1997; Federman & Edwards, 1997; Karayan & Crowe, 1997; Papert, 1997). Central to those studies were the instructional strategies used to encourage interactions among students and others outside the classroom. It is not known whether the access to resources high in sociableness or the instructional strategy itself was related to increases in the learning outcomes.

What is not currently understood is whether there is a significant relationship between developing career interests in science and the use of resources with different combinations of sociableness and webnicity. Thus, if students' interests in science are promoted when they are actively involved with information and people (Super, 1984) and they access more supporting information when using web technology than when not, then unpacking the relationships between the types of supporting information resources used in the classroom and student interests may help to determine which types of resources could be used in science classrooms to inspire students to pursue of science careers.

Research Methodology

A one-time cross-sectional observational method was used to collect data from more than 600 middle school students at the end of the school year (Koszalka, 1999). Student data were collected using a modified version of the Self-Directed Search Career Explorer for Middle School students (Holland & Powell, 1994) and teacher questions drawn from research on integrating technology resources into the classroom (Grabowski & Koszalka, 1998).

A snowball sampling procedure was used to identify middle school science teachers who would be willing to participate in this study. Teachers were not, however, required to have completed any special teaching certification programs or be regularly using any specified procedures, materials, or technologies. All classrooms were required to have school access to Internet technology resources, although there were no requirements that teachers had to regularly use these resources. The students who participated in the study were intact groups from the science classrooms taught by the participating teachers.

The dependent variable for this study was *Science Career Interest.* The science career interest measurement scale was continuous (interval/ratio) with possible scores ranging from 0 to 36. The higher the score, the more interest the student had in pursuing science-related careers.

The student-level independent variable for this study was gender that has been shown to be related to an adolescent's interest in science careers (Boone & Butler Kahle, 1998; Hill et al., 1990).

Teachers were asked to provide information on the types of resources used regularly in the classroom. Classrooms were classified into resource use types based on an indication of whether the resources had been used regularly during science class, i.e., 5 or more times during the school year (Becker, 1998). Classrooms were coded into only one of four resource types:

1. Low sociableness and low webnicity–use neither human or web resources 5 or more time per year,
2. High sociableness and low webnicity–use human resources 5 or more times per year and web resources less than 5 times per year,
3. Low sociableness and high webnicity–use human resources less than 5 times per year and web resources 5 or more times per year,
4. High sociableness and high webnicity–use human and web resources 5 or more times per year.

At the beginning of a typical science class, teachers provided students, who had received parental consent, with a paper and pencil survey of their career interests. The teacher collected the completed surveys and signed consent forms and returned them with completed teacher surveys in a provided mailer.

All data used for analysis were first summarized to provide a description of the participating classrooms and students. All descriptive data were computed using SPSS version 8.0. The complex nature of the multilevel environment of the classroom, where students are nested in classrooms and classrooms are nested in schools, can produce inaccurate measures of relationships unless the characteristics of both the individual student and the groups of students are taken into account (Arnold, 1992). Thus, hierarchical linear models (HLM) were used to examine the associations among classroom-level factors, student-level factors, and science career interest using two-level hierarchical linear models. All estimates were calculated at a .05 alpha-level. Pair-wise deletion was used when missing data was encountered.

Results

A total of 658 surveys, from 23 teachers in 9 schools were administered and returned. Fifty-eight surveys were either returned without signed parental consent forms or with incomplete data and were removed from the sample. The remaining 619 surveys, 94% of the returned surveys, were included in the data analysis that included 51% girls (n=304) and 49% boys (n=297). Eighteen students in the sample did not identify their gender.

This sample of students had a fairly high level of interest in pursuing science careers (M=23.47, SD=5.37). The scores spanned 34 points ranging from a minimum score of 2 to maximum score of 36. The distribution of scores had a slightly negative skew, -.437 indicating a slightly higher frequency of scores above the mean than below. The schools represented East and West Coast middle class suburban/rural middle schools.

The mean science career interest for students in classrooms that used resources low in sociableness and low in webnicity was 17.46, for boys it was 18.10 and for girls it was 16.46. The mean score for students in classrooms that used resources low is sociableness and high in webnicity was 21.95, for boys the mean score was 20.12 and for girls it was 24.19. Students in classrooms that used resources high in sociableness and low in webnicity had a mean science career interest score of 20.68, for boys the mean score was 21.83 and for girls it was 21.52. For classrooms that used resources both high in sociableness and high in webnicity the mean science career interest score was 28.33, for boys it was 23.44 and for girls it was 29.31. (See Table 1.)

Table 1. Science Career Interest and Combinations of Sociableness and Webnicity

Resource Types	All Students M	SD	N	Boys M	SD	N	Girls M	SD	n
Low Sociableness and Low Webnicity	17.46	6.05	68	18.10	7.55	30	16.46	4.44	37
Low Sociableness and High Webnicity	21.95	4.67	105	20.12	5.26	53	24.19	3.69	48
High Sociableness and Low Webnicity	20.68	5.74	88	21.83	5.55	46	21.52	6.01	42
High Sociableness and High Webnicity	28.33	4.66	358	23.44	4.88	168	29.31	4.50	177

Notes: Possible range for science career interest scores is 0 – 36 points; All students: n=619, mean score 23.47; Boys: n = 297, mean score 23.71; Girls: n = 304, mean score 23.12

An HLM baseline analysis of the data revealed that the average mean science career interest score across all classrooms was 23.63. The reliability measure for this data was .871, indicating that the sample means tend to be quite reliable as indicators of the true classroom means. The analysis resulted in a chi square of 196.581 with 22 degrees of freedom and a $p < .000$, indicating that there was evidence of significant difference in science career interest across U.S. middle school classrooms, thus a null hypothesis of no differences in science career interest was rejected.

When classrooms used web resources during science lessons students had, on average, a 3.86 point higher score in science career interest than students in classrooms that did not employ web resources ($t=3.615$, $p<.002$). Similarly, there was a significantly higher score, on average, of 2.68 points in student science career interest in classrooms that used human resources as compared to science classrooms that did not use human resources ($t=2.959$, $p<.008$). (See Table 2.)

The interaction of gender and human resources resulted in a positive estimated coefficient ($t = 1.788$, $p < .088$) indicating that human resources were potentially important predictors of science career interest for boys. The interaction of gender and web resources resulted in a negative estimated coefficient ($t = -1.947$, $p < .055$). Since boys were coded as "1" and girls as "0," the negative coefficient indicated that the use of web resources was potentially a more important predictor of science career interest for girls. Further analysis was required to determine whether the use of human and web resources were indeed significant predictors of science career interest for boys and/or girls.

Table 2. Classroom-Level Resources and Gender

Fixed Effects	**Estimated Coefficient**	**Standard Error**	**T-Ratio**	**P-Value**
Science Career Interest Mean	23.53	.43	54.260	0.000
Use of Human Resources	2.68	.91	2.959	0.008
Use of Web Resources	3.86	1.06	3.615	0.002
Gender slope	0.21	.42	0.499	0.623
Gen X Hum Resources	1.58	.88	1.788	0.088
Gen X Web Resources	-2.87	.91	-1.947	0.055

Note: N = 619, Model 1 Intercept Reliability Estimate = .732

Data were split by gender to investigate the relationships further. The mean science career interest score for boys was 23.69. The use of human resources was a significant predictor of science career interest for boys. When human resources were used in the science classroom, boys, on average, scored 2.68 points higher than boys in classrooms that did not use human resources ($t=2.187$, $p<.048$). Using web resources ($t=1.139$, $p< .269$) did not significantly predict science career interest for boys. The use of both human and web resources ($t=.495$, $p<.626$) also did not significantly predict science career interest for boys. (See Table 3 and Figure 1.)

Table 3. Classroom-Level Resource Effects for Boys and Girls

Fixed Effects	Estimated Coefficient	Standard Error	T-Ratio	P-Value
BOYS*				
Science Career Interest Mean	23.69	.54	44.017	0.000
Use of Human Resources	2.68	2.26	2.187	0.048
Use of Web Resources	2.14	1.88	1.139	0.269
Human x Web Resources	1.29	2.61	0.495	0.626
GIRLS**				
Science Career Interest Mean	23.34	.42	55.207	0.000
Use of Human Resources	4.54	1.78	2.555	0.020
Use of Web Resources	7.06	1.43	4.941	0.000
Human x Web Resources	4.63	2.06	2.252	0.036

Note: * Boys: N = 297, Model 2 Intercept Reliability Estimate = .597
** Girls: N = 304, Model 2 Intercept Reliability Estimate = .514

When human resources were used in science class girls, on average, scored 4.5 points higher (t=2.555, p<.020) in science career interest than girls in classrooms that did not use human resources. In addition, girls scored, on average, 7.1 points higher (t=4.941, p<.000) in science career interest when web resources were used in the classroom than girls in classrooms that did not use web resources. When both web and human resources were used in science class, the interaction effect of both produced, on average, an increase of 16.2 points (t=2.252, p<.036) in science career interest for girls -- interaction effect: 4.5*1 +7.1*1 + 4.6*1*1 = 16.2.

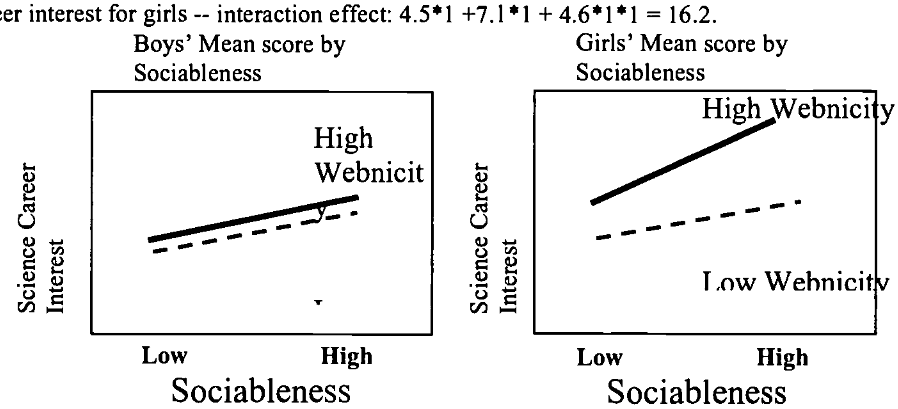

Figure 1. Science Career Interest Scores for Boys and Girls in Science Classrooms High and Low in Webnicity, by Sociableness

Discussion, Practical Implications, and Future Research

Developing interest in specific career domains is a consequence of many learning interactions with the people, information, and objects of the practice (Lave & Wenger 1991). Conceptually, previous research provided indications that working with science practitioners and exploring science information was important in developing interests in science careers (Vondracek, 1993; Helwig, 1998; Hill et al., 1990). The use of *human* and *web* resources during science can provide adolescents with opportunities for exploring science by providing access to additional social and supportive information. Thus, the significant relationships found support a conceptual hypothesis that increasing the richness of information through human and web resources during science class was related to higher levels of science career interest. (See Figure 2)

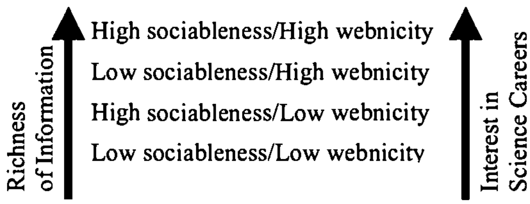

Figure 2. Level of Information Richness

Science career interest was predicted differently for boys and girls given the types of resources used regularly in science class. It was hypothesized that using web resources would support boys' needs to manipulate and explore information using inanimate resources, yet not be significantly related to girls' science career interest because girls were thought to prefer social and cooperative learning environments (Schram, 1996). Thus, web resources were expected to be predictive of boys' and human resources were expected to be predictive of girls' science career interest. Contrary to the expectations of this study and the literature on gender differences, the use of resources high in sociableness was predictive of higher science career interest for both girls and boys. The use of resources high in webnicity had a significant predictive relationship for girls' interest in science careers, but did not predict boys' interests. The literature on gender differences in educational environments theorizes that girls learn better in socially active settings. As young children, girls were inducted into relational modes in which they were encouraged to be conscious of others' needs and be more cooperative, whereas boys were encouraged to be autonomous and to achieve a sense of identify on their own (Boaler, 1997; Head, 1996).

Hyde (1993) cited environmental factors such as cooperative teaching strategies and significant people in the learning locale as influencing girls. Classrooms that encouraged independent, hands-on experimental activities influenced boys. Girls were more interested in animate objects high in sociableness, especially people, than inanimate objects and boys were found to be more interested in inanimate objects, low in sociableness, more than in people. Why then, did boys who were exposed to resources high in sociableness in the science classroom have higher science career interests than boys who were not? And, why would using web resources, e.g., inanimate manipulatives, not be predictive of boys' interest in science careers and be a significant predictor for girls'?

Significant others, such as visitors to the science classroom, influence adolescents both through the interactions with them and through their ability to serve as role models (Darling et al., 1994). A visitor to the science classroom may provide boys with a solid understanding of a complex scientific concept about which the teacher lacks expertise or engage them in challenging discussions about scientific phenomena to increase their investigative skills. Boys may identify with the visitor, especially if the visitor is a male and fits the boys' perceptions of being a scientist (Mason, Kahle, & Gardner, 1991), thus his science career interest could be significantly influenced by the addition of the human resource (Young, Reynolds, & Walberg, 1996). Since details about human resources, e.g. gender, strategies used with students, etc., were not gathered research is needed to confirm these explanations.

It was also surprising to find that using web resources in science class was highly predictive of girls' science career interests and not predictive of boys'. The use of human resources in the science classroom predicted higher science career interest in girls; however, the use web resources predicted girls' science career interest scores seven points higher, on average, as compared to girls who did not have access to web resources. The use of both web and human resources was related to dramatically higher scores in the girls' science career interest. Why were girls' interests in science career predicted by the use of web resources and boys' not?

Girls are generally thought to learn better in social environments and are expected to have strong associations with resources high in sociableness. Girls are theorized to benefit more from social learning activities. Much of the research illustrated that science programs focusing on girls and incorporating cooperative instructional strategies, science equipment, and other science materials influenced girls' interest in science (Mason & Kahle, 1988; Schram, 1996). However, it was not clear whether the influence was from the social nature of the activities, use of equipment, or exposure to new information. Girls could potentially be intrigued by the use of web resources to investigate areas they have not been encouraged to explore previously.

The use of the web may also provide another mechanism for encouraging social interaction in science class on several different levels. First, the low number of computers generally found in classrooms may make it more effective to have students work in cooperative groups while completing science projects using web resources. This type of strategy enhances the social nature of using web resources, thus could explain the relationship to girls' science career interests. Secondly, the use of web resources in the classroom may predict girls' science career interest because girls reportedly do not interact with computer technology outside the classroom as much as boys

(Rocheleau, 1995). The use of web resources may have provided girls in this study with a novel experience thus increasing their opportunities and interest in exploring science content and conversing with science experts virtually.

Boys, on the other hand, have generally been shown to be the heavier users of computer technology outside of the science classroom (Rocheleau, 1995). Because boys are thought to be the heavier users of computer technology, they are most likely to be more knowledgeable of the web and the resources it has to offer. Boys with interests in science are therefore more likely to use the web to explore science-related sites outside of class. Using web-based science resources inside the classroom thus may not be unique to boys thereby, reducing the potential relationship between the use of web resources in the science classroom and their interest in science careers. Additionally, if students are mainly assigned to cooperative activities when using web resources, boys, who prefer to learn autonomously (Boaler, 1997; Head, 1996), may not be benefiting from the use of web resources in the science classroom or be more apt to explore sites not related to science assignments.

Further research is required to understand the circumstances of use that demonstrated significant relationships between different types of web resources and science career interest among girls and boys. Does increasing the amount of time on-line relate to higher levels of science career interest? What types of web resources promote science career interest? What types of interactions with web resources promote science career interest? Is it more beneficial to work in a group or individually during activities that employ web resources?

Understanding the relationships between the use of different types of resources during class and students' science career interests can provide a basis for developing and securing resources that have been empirically shown to be related to higher interest in science careers. If these results hold up in replication studies, there are significant practical implications that may drive educational policy decisions. Given the goal of inspiring students to pursue science careers and the relationship between interest in science careers and use of human and web resources, policy makers should provide financial commitments to enhance computer equipment, facilitate access to science information, and develop communication and working opportunities with scientists and experts in science communities. In addition, commitments should be made to adequately support teachers in their efforts to integrate these resources into their teaching and learning environments. Teachers should be given release time to prepare lessons that incorporate human and web resources and in-service training that focuses on developing strategies and skills to enhance existing lessons with web resources. These efforts would help to increase student access to human and information resources conducive to exploring science.

These findings shed new light on understanding the complex relationships between the use of resources in the classroom and multiple factors that affect the development of science career interest. Without an understanding of the relationships between the types of resources used in the educational environment and student science career interest there is a risk that large investments in educational resources will go unmatched in student outcomes. The results of this study demonstrated that using resources high in sociableness and high in webnicity during science was positively and significantly related to higher levels of student interest in pursuing science careers.

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Action Research on Training Students to Be Independent Learners

Amy S. C. Leh
California State University San Bernardino

Abstract

Technology advancement is shifting our education paradigm. The role of the instructor is changing from an information-giver to a facilitator. Students no longer passively receive information. Given opportunities, students may become instructional resource providers and self-learners. This article reports how the author encouraged students to be resource providers and trained them to be self-learners and self-trainers in an educational multimedia course. Class observations and students' feedback revealed that the teaching methods and new role of the instructor had positive impact on students' learning.

What is a teacher? Who is the teacher? Answers to these questions have been changing in the past few years due to technology advancement. Years ago, teacher was the main information giver and center of a classroom. Lately modern technology has been shifting the education paradigm and providing students with information from a variety of resources via various channels. Consequently the teacher is no longer the center of the classroom.

According to the report released by the National Council of Accreditation of Teacher Education (NCATE) in September of 1997, teachers should develop a new understanding, new attitude, new approach, and new role (NCATE, 1997). Tom Carroll, director of Preparing Tomorrow's Teachers to Use Technology (PT3) grants of the US Department of Education, vividly described the changing role of teachers at the annual convention of Society for Information Technology and Teacher Education (SITE) 2000.

Carroll (2000) advocated that a teacher should take the role of a learner. A teacher is an expert learner while a student is a novice learner. Novice learners may become expert learners as time progresses. As an expert learner, the teacher should facilitate learning for novice learners and let them become instructional resource providers. Creating a learning community that consists of expert learners, novice learners, parents, and members who may foster the learning process, a teacher's responsibility is to facilitate interaction and learning within the learning community and to further expand the community by involving members of other communities.

Hence learning no longer refers to learning from a teacher. A student may learn from other students or any member of the community. A student who does not know one area may be expert in another area. Thus a student may be a receiver at one time while he (she) may be a provider another time. A student may also self-learn from available resources, for example, the Internet. Learning becomes multifaceted and dynamic, and resources become essential in the learning process.

In addition to Carroll, Oliver (2000), an invited speaker at World Conference of Educational Multimedia, Hypermedia, and Telecommunications (EDMEDIA), also supported the idea of using students as instructional resource providers. In his speech, he further explained how he treated his students as resource providers and how his students contributed to the teaching materials. Similar ideas were echoed at two presentations at the convention, Leh (2000) and Santema & Genang (2000). The author of the paper was one of the presenters and was pleasantly surprised to see the idea simultaneously spring up on three different continents, North America (USA, Leh), Europe (Netherlands, Santema & Genang), and Australia (Oliver). This notion might be an indicator of a current global educational trend.

In this paper, the author will share her experience why the role of instructors in Instructional Technology has to change. She then will describe how she played the role of a facilitator and encouraged her students as educational resource providers in an Instructional Technology course. She will also report her students' opinions towards their learning in the course.

The Need for the Changing Role

The author is a university professor who teaches technology credential and graduate courses in Instructional Technology at the College of Education of a public university in the USA. The students of the course were K12 schoolteachers working on their master's degree at the university. Due to state mandate, her students had to integrate technology into their classroom. In addition, because they were master's students in Instructional Technology, they were also expected to help their colleagues in their schools to employ technology. These two forces generated their need to study the use of technology, especially a variety of computer-based software applications and existing technology resources.

How could the author successfully and effectively help her students? She realized that technology advancement had changed how people learned and altered the role of the instructor. She could no longer be an information giver but had to become a learner learning with her students. For example, while the author was a student, she learned HyperCard, a commonly used multimedia authoring program during that time. When she became an instructor, HyperCard was considered to be an out-of-date program and most people no longer used the program. Similarly, while she was a student, only professionals developed webpages. Now webpage development has become common knowledge and a necessary skill for many people. She could not depend on what she learned in school but had to keep learning new technology by herself. Likewise, her students would face the same challenges. They had to become self-learners of technology.

Technology integration requires people's knowledge and expertise of subject areas. The author might be an expert of integrating technology into one subject area, like second language learning, but might not know how to effectively integrate technology into another subject area, for example, science. As a result, the author had to learn with her students who were experts of their subject areas.

Due to the two facts mentioned above, the author changed her role to be a facilitator and hoped to set a good teaching example for her students. She encouraged her students to be instructional resource providers and trained them to be self-learners. She prepared a learning environment in which students could learn by themselves and from each other. The computer applications they learned in her classes might be obsolete one day; however, the learning skills, she hoped, might be transferred and applied to new learning experiences. Illustrated below are her experiences with teaching one of the graduate courses, "Advanced Computer Applications in Education".

Students: Resource Providers and Self-Learners

The goal of the course "Advanced Computer Applications in Education" was to familiarize students with a variety of authoring multimedia software programs. Since this was the only course directly dealing with such applications in the academic program, the author structured the course as a multimedia survey course in which students studied a variety of applications rather than focused on a specific computer program.

She assessed students' skills at the beginning of the course. On a survey, students identified their skills of using the following seven computer-based application software: Webpage development tool, HyperStudio, PowerPoint, PhotoShop, Premier, Authorware, and Director. The students circled one of the following—"don't know", "good", "very good", and "excellent"—which best described their skill level.

The author reported the survey results in class. She intended to help the students use the information to complete their course assignments: developing a HyperStudio project, creating a webpage, integrating PowerPoint in instruction, and offering a technology training session. Course assignments emphasized integrating technology into content areas, independent learning, and learning from each other. Described below is how the students learned from each other in the "Technology Training" assignment.

For the assignment, the students selected their team members (no more than three members in a team). Each team chose and learned one of the software applications mentioned above. Overview of software and step-by-step instruction of using some of the software were illustrated in a course textbook.

After selecting the software program, the students constructed a training plan for a 60 to 90 minute training session. In the training session, they were supposed to teach their classmates the use of the application software they selected. The training plan had to contain (1) assessment, (2) time length, (3) content outline, (4) evaluation, and (5) training materials like handouts or evaluation sheet if applicable. They met with the author to discuss their training. They had to be prepared to answer questions like what prerequisite skills their trainees had, what they would cover in the training, which criteria they used to decide on the content in the training, and how they would evaluate the success of their training session. The students were aware that they could ask for help from the instructor (the author) at any point of time.

Finally they delivered the training to the entire class. The author observed the class and recorded classroom interaction. She also took notes how the trainers could make the training better. After the training, the author first asked the trainers to self-evaluate their training. She then asked the trainees to critique the training session by providing good points and suggestions for improvement. She asked the trainees to provide oral input in class so that the trainers could receive instant feedback and response. She conducted the discussion and concluded with her own critiques. The trainers also received written feedback afterwards from the trainees and the instructor.

Evaluation and Opinions of Students

During the quarter, the author observed the class and interviewed students about their learning experiences in the course. At the end of the quarter, the author interviewed the students and also had them fill in a survey expressing their opinions about the course. The responses were analyzed and categorized. The results revealed that the teaching methods used in the course were deemed to be successful.

The teaching methods highly motivated the students. The students were enthusiastic about choosing a training topic and being actively involved in the learning process. Some of them chose software they were familiar with but more than half of them selected software that they knew little about. When asked why they selected the software foreign to them, the students answered that this would be a good opportunity for them to learn new skills. One said, "I wanted to learn this software for a while. Selecting this topic may push me to learn it." They learned beyond the textbook. Two of them rented a videotape on Macromedia Director. Three of them bought a book and together studied Adobe PhotoShop. They mentioned that they enjoyed learning with their partners. They also expressed their frustration when they explored software, for example, the learning curve of studying a sophisticated software application. Despite the frustration, they cherished the learning experience and thought that they learned a lot from their peers and other resources, not only from the instructor.

The teaching methods generated students' meaningful, active, and constructive learning. For the training plan, the students constructed their own instrument to assess the trainee's skills, decided on training content, and determined how to evaluate their training. They mentioned that instructional design models, for example Dick and Carey's model, made much more sense when they went through the process. They expressed that they spent much time on the course, much more than what they spent on a regular course. However, they liked the experience. They felt that they were the masters of their learning and felt sense of ownership. They mentioned that this learning experience would influence how they learn and how they teach in the future. They would search for resources that could foster their learning, and the instructor would only be one of the resources. They would also try to play the role of a facilitator rather than an information giver in their classrooms when appropriate.

The author required the students to critique their classmates' training sessions. She noticed that the students could easily say, "You did a great job!" Nevertheless, they had difficulty in addressing points of improving a training session. By requiring the students to specify good points and provide recommendations for improvement, they practiced to think critically. At the end of the quarter, the author noticed the improvement that the students made on critique.

The teaching methods increased the students' self-confidence. Before taking the course, the students often complained that they did not know how to use certain software, for example, webpage development tool, because the instructors did not teach them. The students seemed to count on the instructors and did not feel comfortable of learning by themselves. At the end of the course, the students expressed that the course increased their confidence in learning technology on their own. They mentioned that, if they could learn software with their partners and successfully provide training to their classmates in this course, they should be able to do the same elsewhere. They became comfortable of being self-learners.

The students also benefited from one of the textbooks used in the multimedia course. Many instructors could not include advanced multimedia software in their courses because institutions could not afford the expensive software. The textbook offered a possible solution to the problem that educators and students often encountered. The book included a CD of recent multimedia software—MacroMedia Authorware, MacroMedia Director, MacroMedia SoundEdit 16, Adobe PhotoShop, and Adobe Premiere—and step-by-step instruction on the use of the software. The advantage of such a book was that users could explore and learn the software at low cost, approximately $40 US dollars. They could also independently practice the software. The disadvantage was that saving of files was restricted. Several companies published books similar to the book mentioned above. Because of the opportunity of exploring a variety of advanced multimedia software at low cost, the author highly recommends using such a book to make students learning possible.

Conclusion

Technology advancement is shifting our education paradigm. The role of the instructor is changing from an information-giver to a facilitator. Students no longer passively receive information but may be instructional resources in class. Given opportunities, they may be self-learners and self-trainers.

In a multimedia course, the instructor employed teaching methods allowing her to be a facilitator and her students to be self-learners. It was found that the course motivated students, fostered students' active, meaningful, and constructive learning, encouraged students' critical thinking skills, and increased students' confidence. Class

observations and students' feedback revealed that the new teaching methods and role of an instructor had positive impact on students' learning.

As a university professor in Instructional Technology, the author might have experienced the education paradigm shift and its impact on the role of an instructor earlier or faster than instructors of other subject areas might. However, the changing role is a strong, perhaps inevitable, trend. Every instructor should be open to the idea and explore the possibility and experiment with the opportunity.

As NCATE stated in 1997, teachers need to develop a new understanding, new attitude, new approach, and new role. Every instructor should be open to the changes and further create a learning community in which instructors, students, and community members may contribute, benefit, and generate meaningful learning experiences. One can only look forward to participating in the dynamic learning and expect its positive impact on our society.

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Gender Differences in Learning Strategies within Asynchronous, Open, Text-based and Learning Task-Oriented Cyberspace

In-Sook Lee
Sejong University

Abstract

It is a very recent phenomenon for gender differences to receive attention, even though research on CMC goes back to the 1970s, to an earlier stage in computer technology. The current research reports survey results on gender differences in cyber learning strategies with respect to expression, information processing, self-control, and use of human resources; and suggests instructional interventions to guarantee a gender-free cyber learning environment.

Introduction

Distance education is moving toward a new generation, which is the Internet-based cyber education. Today, functions and advantages of the Internet will be further capitalized for education, especially learner-centered learning. The Gartner Group (1998) estimates that 60% of higher education students will access content electronically by 2003.

Computer mediated communication in which historically males continued to dominate (Herring, 1994) but increasing numbers of female populations are getting benefits from this new technology. Recent reports and studies indicate that females' access to the Internet is substantially improving (Refer to ALMANAC, 1990; Media Metrix, 1999). However, it is still difficult to conclude that females are participating equally with males in the cyberspace. Although especially the Internet among various technologies has been expanding in the educational community worldwide, it is not clear whether all and every learner will benefit equivalently from this new learning technology. It is a very recent phenomenon for gender differences to receive attention, even though research on CMC has been back to the 1970s, to an earlier stage in computer technology (Herring, 1994).

Learner issues are the core elements for success in cyber education (Bonk & Dennen, 1999) and learning strategies among those issues are especially significant factors. Cyberspace is a highly learner-centered place, where learners should take more responsibility for their own learning. This is primarily due to the nature of cyberspace, which is represented by time and space independence, openness, constructiveness, and webbness. Therefore, learner issues are the core element for success in cyber education; and learning strategies, through which learners themselves regulate their own learning process, are taking a more critical part than instructional strategies. Nonetheless, the existing literature on learning strategies in cyber space is limited and none of it focuses on gender differences. The current research reports survey results on gender differences in cyber learning strategies as follows:

(1) How do genders differ in 'expression' in cyberspace?
(2) How do genders differ in 'information processing' in cyberspace?
(3) How do genders differ in 'self-control' in cyberspace?
(4) How do genders differ in 'the use of human resources' in cyberspace?

Literature review

Learner characteristics

A great deal of distance education literature supports the claim that learner characteristics are very critical factors for achievement and satisfaction levels in distance education (e.g. Willis, 1994; Smaldino, 1999; Simonson, 1999). Willis (1994) suggests adult distance learners' success factors including tolerance for ambiguity, a need for autonomy, and an ability to be flexible; and failure factors including preference of a great deal of structure, face-to-face lectures and the opportunity to interact with instructors.

The goal of planning cyber education programs is to provide learning experiences and environments based on the each learner's needs so to 'makes the sum of each learner equivalent' (Simonson, 1999) by incorporating the proper design elements and instructional strategies.

Cyberspace and learning strategies

Substantial numbers of literature lead us to the conclusion that learning strategies take the important roles for learning performance (Dansereau, 1978; Weinstein, 1978). Ignoring learning strategies is basically discouraging

learners from developing and exploring their own new learning strategies. Nonetheless, relatively insufficient attention to learning strategies is found in the current cyber education literature. Burge and Eastmond found that learners in online context transfer many of learning-to-learn approaches from traditional learning contexts to online setting. At the same time, however, they identified that online environment requests learners idiosyncratic learning strategies. Burge (1993) found learners using learning strategies with respect to making choices, expression, group interaction, and the organization of information.

Eastmond (1993) found that learners in computer conferencing based online courses employ strategies to deal with multiple discussions, information overload, synchronicity, textual ambiguity, and processing online information and determining what contributions to make. Conferencing systems, basically with a hypertext structure and led by learner participation, demand of learners a high level of self-regulation and meta-cognitive abilities in the learning process.

Lyman (1998) suggests that cyber learners need to develop learning strategies called 'information literacy' in order to take benefits from the Internet. The abilities especially required in a resource-based learning environment through the Internet include the followings:

1. know when there is a need for information
2. identify information needed to address a given problem or issue
3. locate the needed information
4. evaluate the information
5. organize the information
6. use the information effectively to address the problem or issue

Cyber learning space is typically structured with hypertext and is heavily expected to be the one that is strongly learner control oriented. Learner-oriented environment demands learners to make decisions by themselves throughout the learning process and, therefore, requires a high level of self-regulation and metacognitive abilities. It is important for learners and in particular for novices in a cyber-hypertext environment to acquire learning strategies. Learners who cannot use effectively the complexity of cyber communication environment, therefore, need explicit modeling and scaffolding support as well as more experiences in hypertext-based, open, flexible technologies for constructive learning.

Gender issues in cyberspace

Issues of relationship between technology and gender in education have been increasingly explored in recent years (Kerr, 1996). Probably due to the short history of cyberspace within educational sectors, however, little attention has been paid to the issues of gender difference in and even less regarding the issues of learning strategies. Most frequently appearing research issues are the ones regarding styles or purposes of social interactions and dynamics, attitudes; and styles and frequencies of expression, discussion, and feedback.

Methods

The subjects were 156 undergraduate students, 35 males and 121 females, from a medium size university in Seoul, Korea. As a reference, Korea is one of the countries most aggressively experimenting to maximize educational benefits of the Internet. Recent statistics indicated that Korea was the 10^{th} in the Internet users as of the end of 1999.

These students were varied in terms of their academic backgrounds and years in their programs. All of the courses were integrated with a web-based instruction tool, UniverCampus. Cyber learning and instruction in this research is basically asynchronous, text-based, open, and learning task oriented features; and was operated with combined with face-to-face class. Instruction/learning room (figure 1) and discussion room (figure 2) were used as two main learning spaces. Instruction and learning room provided learning materials, simple discussion issues, and quiz activities. In the discussion room, typically the professor posted discussion topics and specified the timeline; and learners were expected to discuss about it within the timeline.

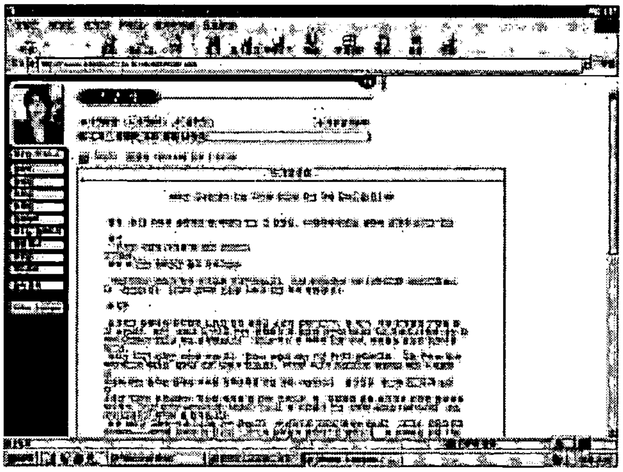

Figure 1. Instruction/Learning Room Sample Screen

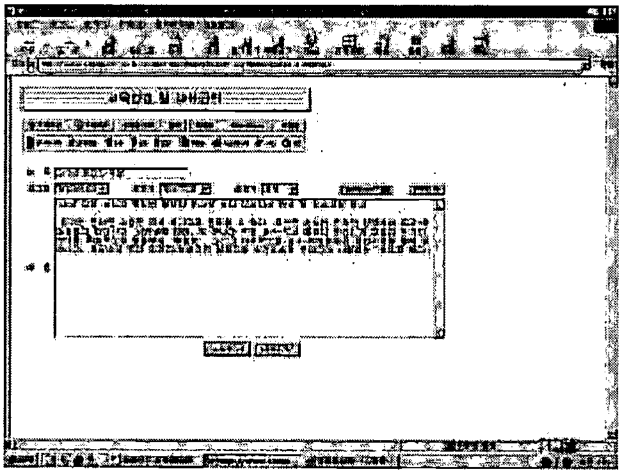

Figure 2. Discussion Room Sample Screen

Cyberspace in this research was typically used to facilitate learner-learner interaction, more specifically peer discussion, idea-sharing, critique, feedback, and review. Further, it intended to facilitate learner-instructor interaction, including assignment posting and submission, and question-and-answer session. In addition, it supported to provide additional learning materials, as learner-material interaction. Throughout the semester, learners were encouraged to contact assistants and the professor as they need help. At the outset of the semester, one-hour orientation covering how to use the online tool was offered.

A 28-item questionnaire survey was conducted during the final week of the semester. The questionnaires were organized into four categories: expression, information processing, self-control, and the use of human resources. Each item was designed with 7-point Likert type scales, using values of 1 for "strongly agree" and 7 for "strongly disagree". Post-hoc, internal consistency reliability of the survey was measured to be Cronbach r =.86. T test was computed for the questionnaires and 7-point Likert like items with negative descriptions were reversed for convenient interpretation.

Results and discussion

Expression

Responses, in general, indicate that males appear to use more proactive and aggressive expressions than females and feel less mental pressure. More males perceived themselves actively presenting opinions ($p<0.05$) and felt fewer difficulties in expressing ideas in a written form within the cyberspace ($p<0.05$). Moreover, more males are positive toward cyber discussion (means = 3.86); on the contrary, females are more likely to be negative toward it (means=4.35) ($p<0.05$). Those results can be discussed in terms of core nature in this research cyberspace of text-based, open, formal, and task-oriented. The cyberspace of the present study is text-based and open space, where participants were expected to conduct open discussion within specific learning purposes, not for personal and social and information dialogues: Therefore this implies very much male superior and male dominating features (Ebben, 1994; Fishman, 1997; Hatton, 1995; Herring, 1993; Herring, 1994; Herring, Johnson, & Dibenedetto, 1992; Kramarae & Taylor, 1991; McDowell & Schuelke, 1998; Selfe & Meyer, 1991; Spender, 1995; Tannen, 1991). In this context, female students tend to have relatively higher appreciation to communication than males; motivationally or behaviorally discouraged eventually in posting own opinions or providing feedback to others. These apprehension and dispirit can function against full or appropriate use of learning strategies required to be successful in the cyber communication system.

In addition, females showed stronger appreciation about expressing ideas in a written form in the "real" space ($p<0.05$). Those findings, as a whole, confirm various existing research that learner characteristics in real space are highly transferred into cyberspace (McDowell, E. E. & Schuelke, L. D., 1998; Fishman, 1997).

Processing of information

12 questionnaires were asked with respect to information overload, information decoding, and mental pressure of asynchronous interaction. Males appear to outperform females in perceptual and behavioral strategies as well. If overloaded, more females tended to skip reading others' postings than males ($p<0.05$). In addition, when messages were overloaded, females (mean score = 4.33) tended to feel more difficulties in selecting and appreciating them than males (mean score=3.8) ($t=-1.917$, $p = .057$).). These results imply that more females may lack skills and strategies for managing information overload in cyber space and, as a result, experience more obstacles in cyber learning process than males.

In spite of no significant differences in the degree of "reading" messages posted by other learners, the degree of "dislike" of reading them was significantly different between genders ($p<0.05$). This result may indicate that cyberspace which is time consuming due to its text ambiguity (Mason, 1994) still put more mental stress on males, comparing to males.

On the contrary and interestingly, females outperformed males in submitting assignments or learning activities corresponding to instructors' statement ($p < 0.01$). There was no statistical difference with respect to motivational strategy needed for asynchronous communication ($p=.066$). Considering mean scores, however, males tended to be more positive (means=3.83) toward asynchronous communication; on the contrary, females were more likely negative (means=4.27).

Self-control

Since cyber learning environment strongly requires learner control (I-S Lee, 1999b; J-K, Lee, 1999; J-H, Lim, 1999; M-H, Jo, 1999; I-S, Jung, 1999; O, Cho, 1999; Keegan, 1990; Mason, 1994; Bonk & Dennen, 1999), learners need self-control strategies for a successful cyber learning. Therefore, this research tried to determine gender differences in self-control through the questionnaires employing the items of time management, diligence, and persistence. The analysis, in general, revealed no statistically significant differences between genders except the following. Females are more likely to outperform males in submitting assignments or participating in activities within due date ($p < 0.05$).

Use of human resources

Two items were employed to determine whether any differences existed between gender with respect to use of instructors, assistants, or colleagues in order to solve any instruction or supportive problems during the cyber learning process. The analysis revealed no statisticallysignificant differences.

Conclusions

This research reveals significant gender differences in the categories of expression strategy and information processing strategy, in which males showed stronger abilities and positive attitudes without exception. The findings are not entirely surprising, since they replicate many of the existing findings from the areas of communication, linguistics, and sociology and more.

Currently dominant modes of cyber courses demonstrate structures and functions in favor of males. However, it should not be taken for granted; we have to move toward a gender-equal cyber learning environment. This can be achieved by including instructional design and implementation, which might more likely respond to learning strategies in favor of females. Of greatest potential leading to gender inequality in a cyber learning environment is its text-based, public, and information overload natures. I suggest the following instructional interventions to overcome potential negative impacts of those natures on female learners.

First, considering that females tend to experience difficulties in thinking and expressing in a written form, there is a need for providing additional interaction modes, which might support rather a dialogue-like interaction. Real time chatting is one of the exemplars of instructional intervention. In addition, sound materials and interaction through voice messages should be used more substantially.

Second, considering that females tend to experience difficulties in public postings and arguments, there is a need for learning opportunities through rather informal and social interactions. Among others, I suggest designing learning spaces for small group discussion and reading materials for individualized learning. Individual learning activities, rather than too much focusing on learner-learner interactions, might be instructional interventions useful for females who demonstrate rather high apprehension in public interaction.

Third, considering that females rather tend to experience difficulties in reading others' messages, when especially overloaded, there is a need for interface design which might help individual learners to search, organize and present information in their own convenient way. Concurrently, it is equally useful for mediators to regularly provide summary notes of shared information and ideas among learners.

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Fostering Design Culture Through Cultivating the User-Designers' Design Thinking and Systems Thinking

Li, Ming-fen
National Taiwan Normal University

Cultivating design thinking and systems thinking for building a design culture

Since Cross (1990) claimed that design is a unique mode of culture, like science culture and humanities culture, the cultural aspect of design has received more and more attention in the design community. Banathy (1996) is probably the most well-known scholar who profoundly interprets Cross' thinking about design culture. He states that it is important to build a design culture through cultivating the general public's design competence and design literacy. However, I contend that we need to focus on ways of cultivating design thinking and systems thinking if we want to foster a design culture in the learning society. Because our thinking is constantly interacting with our action, which becomes the essence of our daily experience, and gradually shapes the forms and content of our culture.

Indeed, the significance of design thinking and systems thinking to design has gained much recognition in recent years. Tripp (1991), Rowland (1994), Akin (1994), Nelson (1994), Banathy (1996) have expended much efforts in analyzing and synthesizing design thinking and systems thinking since 1990. Compared to design thinking, scholarly discussion about systems thinking has a much longer history and includes more multiple and divergent perspectives. Some major systems theories have been successfully applied in organizational change, such as Senge's systems thinking, Checklend's soft systems methodology, Ackoff's design of idealized systems, and Nadler's planning and design approach. However, in this paper, I would focus on Banathy's and Senge's systems thinking. Meanwhile, I would propose an enlightening design approach, the DESIGN-WITHIN approach. This approach aims at enhancing both learners' inner revolution and societal learning revolution. Through design-within, we could engage learners and the learning community in envisioning their learning, and in systemically designing their own learning. Indeed, design thinking, as well as contemporary systems thinking are two wings to make us fly in the spacious learning world. The design-within approach is an alternative approach which synthesizes the truly systemic spirit of systems thinking and the enlightening spirit of transformative design.

The emergence of design thinking and its multiple perspectives

Design thinking is a historically well-developed discipline across many fields. However, in the field of instructional design, it has long been confined within strategic or systematic mode of thinking. Its rich essence is yet to be discovered. However, the following contemporary perspectives on design thinking have pointed out a much spacious world for instructional designers to explore.

Creativity and design

While clarifying the essence of instructional design and development, Davies (1981, 1994) attempts to uncover the multiple facets of it. The way he frames design in the craft, science, and art facets is very illuminating. He pinpoints the kinds of design and development possibilities from the "process" perspectives, and proposes a "process design" approach for corporate training. Rowland and Wilson (1994) look into the creative processes of design by exploring the essence of Csikszentmihalyi's flow psychology. They contend that to situate the designers in liminal states is critical to nurture their creative thinking. They enumerate several contexts that could trigger the designers' mental occurrence of liminal states. Most important, they depict design as the designerly ways of knowing, which is resonant with Banathy's interpreting design as a mode of inquiry. Meanwhile, Rowland (1993) investigates the design process of expert designers across many different design disciplines. By synthesizing the commonalities underpinning many design-related fields, he enriches our thinking about and understanding of the "design process".

Compatively speaking, the way Nelson (1994) approaches design is quite unique. He contends that design as learning is quite different from the traditional understanding of learning. He uses the concept of feedback for further explanation. He argues that "feedback in learning process is typically presented as positive or negative. Design learning involves another less known system's process that can best be characterized as feedforward; inquiry pulled by volition and purpose. It is not about discovering correct or incorrect predictions neither about describing reality in terms of truth. It is discovering knowledge at the edge between chaos and order; between the unknown and the known. Design learning is also pragmatic in the discovery and mastery of skills needed to bring about

abstract concepts into lived reality (p.52)." Nelson (1994) advocates that we should have more patience to live with fuzziness of design and to undisciplined design. He also claims that design includes, but goes beyond, the theory of a science of the artificial in that it deals with the social organizations, patterns of human interactions, and functional social-technical structures that serve human purposes. Design is a synthesis of creativity (imagining new things) and innovation (bringing those new things into existence) within this multi-dimensional domain. It is both process and artifact. Compared to Davies and Rowland, Nelson seems to hold a more moderate stance.

Design as problem-solving vs problem-restructuring vs dialogical process

As an architecture design researcher, Akin has very different perspectives on problem solving and problem restructuring from many other researchers. He affirms that problem-restructuring is by no means a newly discovered phenomenon, but has a rather long history in design research and even historical discover on reasoning. We need to be aware that here Akin focuses much on "problem restructuring", rather than on problem-solving or problem framing. It is such problem-restructuring process that underlies design, and represents design as a unique profound discipline. We can say that the way Rowland situates designers in the liminal states for generating creative design is very similar to the way Akin emphasizes on engaging designers in the problem- restructuring process. Beyond our common-sense knowledge of problem-solving, Akin holds the views that the less understood a problem domain, the more the degrees of freedom the designer has and less reliance on standard solutions can be expected. Like Rowland (1994) and Banathy (1994) who believe that to design is to leap out from the present to the possible future, Akin thinks the process of creative design is to leap out of the framework to explore other possibilities or expand the boundary of the problem domain. Although Schon's research on professional practice is not limited to design-related fields, his thinking about problem solving has great implication on design. In fact, Schon (1985) is more pragmatic in terms that he values both problem-solving and problem-restructuring process. He regards problem solving and problem restructuring as the indispensable dual process, which provide us with the moderate way of knowing and action about design.

From these discussions, we could find that design thinking encompasses multiple perspectives. Instead of listing the various definitions of design, I would first synthesize Tripp's (1991) and Rowland's (1993) discussions about the design process and design nature, and then summarize Banathy's discussion about design nature and design culture in the following section. Tripp (1991) reviews numerous empirical studies of design across the general design field, such as engineering, architecture, software design. In probing the nature of design, Tripp tries to clarify if a theory of design can be constructed. Thus, he synthesized many divergent views of design into two general theories of design. According to Tripp, there are two different theories of design, namely design as optimization and design as dialogue. The former is in the same vein of Simon's perspectives (1981) whereas the latter is in aligning with Schon's (1987) reflection-in-action. They have various focuses. Design as optimization usually takes logical, rational, systematic processes. Yet, design as dialogue takes intuitive, creative, artistic processes. In terms of problem-solving in the design process, optimized design places emphasis on complete understanding prior to solution attempts in order to finding the best description of the problem. However, dialogical design takes early attempts at solution. Therefore, it is not like optimization design that treats design as an instance of problem solving. Instead, design is treated as a reflection-in- action process, and a social process of negotiation, hermeneutic in nature. In contrasting to optimization design's focus on formal representation of problem-heuristics activities, dialogical design usually embeds uncertainty, uniqueness and conflict.

From the above discussion, we could find that design has been inquired from various perspectives, which indeed range from design product (artifact), to design skills and strategies, to design process, and to design thinking. Rowland traces the process of design by finding out the converging arena of instructional design with design. He studies the relationships between design and instructional design from the 4 facets: the purposes or goal of design, relationships to other processes, factors that influence the design process, and the nature of design process. In addition to exploring the designers' creativity, and the design expertise, Rowland extends much of his scholarly discussion to the issue of nurturing the dialogical culture within the design community. This is very different from simply embedding the dialogical strategy to the design process. Indeed, Rowland and Wilson's conceptions of designerly ways of knowing and Rowland's discussions about design "culture" make design thinking the indispensable knowledge base of instructional design.

Design culture

While clarifying the nature of design, Banathy (1996) enumerates the various definitions of design from various design-related disciplines. He found that the various definitions of design convey the notion that design is practiced by many professions, in many different ways, and is applied in various contexts. When extending Cross' design as a mode of culture, he advocates that we should not leave design decisions affecting our society to the so-

called design experts. Instead, we should include a broad-based participation of the users in the design of their systems. We should build design cultures that include the general public in order to complement the expert culture of professional designers. However, if we want to include the general public in the design process, we need to cultivate the public's literacy in design. He affirmatively states that our era can surely be called the age of design. He suggests that in the age of design, the building of a design culture is an inescapable necessity. Because, if we take away design, we strip the world of most of its enabling mechanism. He urges the public to make choice for themselves, not simply relying on the experts' design thinking and decisions. Because we can either live with the poor design by the so-called experts, or we can empower ourselves by acquiring design literacy and design competence so that we can assume responsibility for the design of systems in which we live and to which we are connected.

Indeed, we should not be engaged in design simply to fix or complemement certain aspects of the whole learning environment. What we need is to create a new image which is more encompassing than the original one through reflective, critical and enlightened thinking. We also need to cultivate the designers', user-designers' or the design community's critical awareness of their beliefs and values that underlying their design thinking and action. Like the way Senge clarifies unwhished vision and wanted vision, Banathy makes clear difference between improvement and restructuring. Through such clarification and distinguishment, we could better understand that design is a unique mode of thinking, not an add-on to any other disciplines. In particular, Page's (1966) "design as an imaginative jump from present facts to future possibilities" seems to provide a clear direction for designers to strive for. But, here emerge some fundamental questions:

- How could we transform the current reality by design?
- Do we need any other disciplines than design to attain such transformation?
- While trying to generate the design image of the new reality, how should we cope with our own habitual design thinking and action, which is so deeply ingrained in our mental models?
- How would users and designers interact in the design culture?

Link between design thinking and systems thinking

Although design thinking and systems thinking seem to be literally different, they are two interrelated concepts when applied in learning or instructional design. When dealing with design issues, instructional designers inevitably face the complicated learning or educational systems. Indeed, design is a powerful bridge to integrate systems thinking into learning or instructional practice. This is why Banathy (1996) highlights systems thinking as the conceptual environment or parent of design thinking. He regards that design is one of several disciplined inquiry domains of social systems in which systems thinking is manifested.

Banathy's intellectual technology—"designing" social "systems"

Indeed, Banathy has been engaging himself in the design inquiry since the 1960s. While he is well known as an enthusiast for systemic design of educational systems, his efforts in advocating design literacy and culture is less well known. Part of the reason may be because of the complexity and profundity of his design thinking. In "Designing social systems in a changing world", Banathy (1996) endeavors in historical and extensive scholarly discussion on design. He compares design and other modes of inquiry, and treats design as one of the three cultures, science, humanities and design. Furthermore, he tries to envision the new social systems by regenerating design, trying to bring design to the social system, the educational contexts, and everyone's life. His design thinking is closely linked to his systems thinking. In another words, his design thinking is to be realized and carried out in the open social systems. We can say that he has depicted a spacious and magnificent landscape for the designers to travel.

Banathy advocates that we need creative and proactive design visions to transform the social, educational reality. He not only defines design and social systems, but also comprehensively compares design and other modes of inquiry, and approaches design from the cultural visions. He defines design as a multidimensional inquiry by synthesizing systems thinking, design thinking and other multiple perspectives. He also tackles the ethics of social system design and the design of the ideal system. In essence, he integrates a wide range of knowledge in approaching his inquiry of design. His contribution to design inquiry is that he elegantly and profoundly synthesizes design thinking and systems thinking.

Nelson's designers as symbolic synthesizers

While Banathy conceptualizes social systems design as intellectual technology, and integrate systems thinking in his social systems design inquiry, Nelson cautiously probes the reasons for engaging in systems design. He claims that we need to know about why systems design is in need for the new age, and contemplates that system

designers as symbolic "synthesists", whose role is inclusive of what a symbolic analyst does, is an emerging significant role for a complex world, working in environments of complexity.

He asserts that new times need new designs. Therefore, learning systems design should involve the synthesis of two very important intellectual traditions which are gaining prominence with the establishment of the information age: systems thinking and design action. He further explains that systems thinking provides a framework for describing or conceptualizing the complexity, interconnectedness, and nonlinear dynamics of institutional and organizational systems, while design provides the action framework for how to visualize and bring into existence, in functional form, telelogic systems (i.e., serving human purpose). Of the two, systems thinking is the most developed theoretically. Design is the most developed pragmatically but is in need of the most development conceptually in order to more fully enhance the synergistic potential in combination with existing systems thinking.

Nelson's (1994) thinking about design is special in three aspects: First, he argues that problem solving and design are entirely two different phenomenons. Design is a special way of thinking-different from scientific thinking-that is performed "out of control", with a deliberate break from restrictions on imagination. Second, in defining design, he distinguishes between self-expression of the arts and other expression of design. He describes the relationship between designer (self) and the client (other) as synergistic, as becoming more capable of more than the client or designer separately. Third, like Banathy, he links systems thinking to design thinking, and argues that we need to move away from thinking in separate disciplines of expertise. He offers the integration of systems and design as a powerful perspective for meeting current organizational challenges.

Systems thinking as another wing to take us to the spacious learning world

Systems thinking has played a critical role in the historical development of educational technology since 1970s. The instructional design models which adopt systems thinking were once widely recognized in many educational and training contexts. Despite the positive recognition of its value to education and training, the essence systems thinking is narrowed down to "systematic" view, distorted its true spirit greatly. While constructive learning and situated learning gain more and more attention in the area of instructional design, the way systems thinking has been interpreted and applied is also challenged. Although some scholars turn to systemic views to broaden their perspectives on systems thinking, its essence has yet been thoroughly studied. I believe that deeper understanding and discussion about various modes of systems thinking is essential for uncovering the potential significance of systems thinking in terms of fostering design culture. At the fundamental level, cultivating user-designers' systems thinking for design is more important than developing more systematic or systemic models for them to use.

Therefore, in addition to reviewing, analyzing and comparing the design thinking mentioned above, I would focus on Banathy's and Senge's systems thinking. Because Banathy not only synthesizes and critically reviews many system philosophers' systems thinking, but also integrates successfully systems thinking into his design inquiry. He integrates a wide range of knowledge of design thinking and systems thinking when undertaking his design inquiry to transform the social systems. His contribution to design inquiry is that he elegantly and profoundly synthesizes design thinking and systems thinking by pointing out the route to transforming the existing educational systems into the ideal creative system. Senge's systems thinking, as he refers to as the fifth discipline, is embodied in and interacting with other disciplines (i.e. personal mastery, shared vision, team learning & mental model) to help a team or organization to cultivate their learning culture. His systems thinking and other disciplines to be practiced with systems thinking has been widely recognized in restructuring organizational learning culture. In the past two years, he and several other researchers and practitioners also develop organizational learning through the five disciplines in the educational contexts. Therefore, his systems thinking as well as other disciplines has great implications on fostering an organization's learning culture.

Systems thinking and open educational systems design

Banathy's visions of systems thinking underwent great change in the 1970s. Earlier than that, he regarded instructional systems as close systems to be well thought and designed like many instructional technologists. In the book "Instructional Systems", he was still confined within closed systems engineering type of thinking to construct the instructional systems. Even so, the instructional systems he proposed is much more systemic compared to many instructional design and development models in the 1970s and 1980s. Yet he believes that as long as the instructional systems are closed, they are useless in the domain of social systems, and even counter the spirit of learning and education. Therefore, he proposes an open-systems view to deal with the educational problems, and published "Developing a systems view of education: A systems models approach in 1973. In the past 2 decades, he has been advocating his design thinking and systems thinking to designing social systems. He attempts to diffuse systems thinking and the dynamism of it to the educational community. In 1996, he finished his system design

theory, which encompasses 3 models for redesign the educational system, i.e. a system-environment model, a functions/structure model and a process model. The three models are to be applied in two aspects: First, they are to depict the systems concepts and the systemic level of the way we understand the educational structure of the existing systems, and the way we evaluate the educational environment. Second, they are used to design the new educational systems by comparing the gap between the ideal conceptual systems and the existing systems. He not only designed the 3 models but also provide many activates to guide the users to apply his models, through which users might gradually cultivate their systems thinking and systems application capabilities. In terms of this, Banathy seems to be much closer to Senge, both of whom do not intend to merely invent models and theories for users and learners to apply, but engage them in the thinking process and problem-solving processes. Unlike many instructional technologist who make much efforts on constructing design models and theories, Banathy claims that more efforts should be expended to cultivate the instructional technologists systems thinking, and their literacy of systems theories and systems methodology, which he has been persistently working on.

In referring to Stafford Beer's vision that human beings are prisoned by their own thinking, Banathy tries to construct his systems models to expand our cognitive power, and enhance our capabilities to deal with complexity. He found that traditional science defines complexity by examining the multiple components within a system, whereas systems science defines complexity by the interaction between the system and its environment, and by the relationship among the components within the system. What makes a difference is that the former is a close, static system, but the latter is an open, dynamic system. It is essential to recognize that Banathy's systems thinking is to be applied in the open social systems, and closely linked to the concepts of synthesis and expansion, rather than analysis, which underlies most traditional instructional design and development models. He argues that through synthesis and expansion we can better understand the systems and its relationship with the larger systems or environments. Meanwhile, we should shift from anticipating, predicting and controlling the human world to understanding the uncertainty and complexity of the environment.

However, while applying Banathy's systems models to designing educational systems, we need to reflect upon how our habitual thinking, acting and problem-solving patterns might counter the new design thinking or systems thinking. Because no matter how sounding the systems methodology or models are, human thinking and acting tend to follow their habitual routes, rather than new, less traveled routes. Especially when the user-designers are engaged in team work, such reflection on the gap between their old and new thinking is even more important. Because everyone's understanding and acting upon the system methodology and models may diverge at different levels and dimensions. Therefore, how to cultivate all design participants to use design language or system language at a more communicable platform becomes a fundamental, significant issue. If users or learners do not have full understanding and communication of the visions of the ideal systems, or could not form a design team, they might add another dimension of complexity to the system itself. Indeed, the human factors which interfere with or even fail many restructuring tasks in education are not uncommon at all.

From Banathy's systems thinking, we have a much broader view of what systems are and how systems thinking might be applied to solve the existing problems or design new educational systems. Such systemic perspectives do help expand our cognitive power about systems and reconceptualize our rigid understanding of instructional or educational systems. However, as mentioned earlier, the user-designers or learners should be provided with ample opportunities to reflect upon their habitual thinking and acting which might have interfered with their engagment in systems thinking or even prevented them from understanding the new mode of thinking. Because transforming one's inner habitual thinking, acting and ways of design may be more difficult than redefining and clarifying the system problems, or generating strategies to create the ideal systems. To overcome this, we could gain much insights from Senge's systems thinking.

If we could undertake the task of design from alternative perspectives, we might be able to shift design focus from designing learning product and environments to cultivating their thinking and actions about design. Below, I will analyze and critique Senge's systems thinking, and its practice with other disciplines for regenerating a learning organization.

The essence of Senge's systems thinking: Philosophical roots in both western and eastern culture

Senge's systems thinking has profound philosophical roots in both western and eastern cultural traditions. While developing his systems thinking, he converges much ancient Chinese wisdom with traditional western philosophies, and, furthermore, integrates them into the theory of systems dynamics. If we interpret Senge's systems thinking without recognizing its profound philosophical roots, we may not be able to capture the wholeness of his systems thinking. Through critically reviewing the essence of Senge's systems thinking, I found that his systems thinking is framed from views of learning, time and space, cause and effect, universe, structure, and working ethics. He argues that "learning" has lost its central meaning in contemporary usage, because learning has come to be synonymous with "taking in information." Yet, taking in information is only distantly related to real

learning. Learning should involve a fundamental shift or movement of mind. Real learning gets to the heart of what it means to be human. It is through such learning that we re-create ourselves. In other words, true learning should be transformation of spirit and mind, not merely accumulation of information or knowledge. Furthermore, he proposes that we need to transform the technical mode of working into the spiritual pursuit of working ethics.

Senge also thinks that our distorted views of time and space often destroy our patience because we can easily encounter a current problem, which is indeed resulted from yesterday's solution. The relationship between cause and effect is not closely related in time and space as we always imagine and expect. Very often our impatience and intolerance with the effect makes us rush into erroneous judgment or decision-making, which is even worse than no judgment or decision at all. His perspectives on universe distinguishes him from other systems thinkers greatly. He does not define the components of systems or categorize the types of systems, but emphasizes that the line between inside and outside, parts and wholes is indeed very arbitrary. Because we tend to treat problems as if we are outsiders, rather than treating the problems and ourselves as oneness, we often unconsciously complicate the nature of the problems. Based on these philosophical thinking and perspectives, he develops several laws of systems thinking, such as "Today's problems come from yesterday's solutions.", "The harder you push, the harder the system pushes back.", "The cure can be worse than the disease."

Systems thinking as a thinking language to be cultivated

Like many other systems thinkers, such as Banathy and Checklend, Senge's systems thinking is also a discipline for seeing wholes, a framework for seeing interrelationships rather than things. But, his systems thinking is not only characterized by seeing wholeness and interrelatedness of systems, but also , by seeing patterns of change. He regards systems thinking as a discipline for seeing the "structure" that underlie complex situations, and for discerning high from low leverage change. Because he thinks structure influences behavior, and structure in human systems is subtle. The reason that structural explanations are so important is that only they address the underlying causes of behavior at a level that patterns of behavior can be changes. Therefore, he claims that we need to look into the underlying structure of many organizational behaviors, not being confined within the incidents or patterns of behaviors. It is only when we see the systemic structure could we be collectively engaged in generative organizational learning, not responsive or reactive learning.

Another unique aspect of Senge's systems thinking is that Senge constructs systems thinking as a thinking language to be learned, practiced and cultivated. It is used to capture the structures underlying the individuals' or organizations' behavior structure. He develops 3 primary thinking tools for cultivating systems thinking: (1)feedback loop 1--reinforcing loops: when small changes become big changes, (2) feedback loop 2—balancing loops: pushing stability, resistance, and limits, and (3)delays: when things happen....eventually. In order to guide us to learn these thinking tools, he develops four toolboxes. They are (1) learning how to draw systems maps, including the interaction between cause and effect, its dynamic loop, system feedback perspectives, anti-agnosticism, and sharing systems problems, (2) learning how to describe reinforcing loops, (3) learning how to describe balancing loops, and (4) learn how to describe delays. Senge identifies the limitation of our written and spoken language, and thus tries to demonstrate to us how systems thinking can be represented through drawing systems maps, systems loops, nodes and time delay. He translates his long-term observation of and experience with recurrent organizational learning development and problems into "systems archetypes." Such systems archetypes are used to frame structural, and rooted problems of certain organizational behaviors or phenomenon. They are found in many organizations, include limits to growth, shifting the burden, eroding goals, escalation, success to the successful, tragedy of the commons, fixes that fail, and growth and underinvestment. In addition, he regards systems thinking as the fifth discipline which is the conceptual cornerstone underlying all of the five learning disciplines, team learning, shared vision, mental model, personal mastery and systems thinking itself. According to Senge, all of the five disciplines "are concerned with a shift of mind from seeing parts to seeing wholes, from seeing people as helpless reactors to seeing them as active participants in shaping their reality, from reacting to the present to creating the future. (p.69)." We should identify the fact that systems thinking has been successfully integrated to the teaching of many school subjects and many organizational learning-training programs. Its potential and value to education really needs further exploration.

Comparison of Banathy's and Senge's systems thinking

Generally speaking, Senge's systems thinking not only has Banathy's systemic view, but also has its unique features. From his profound systemic views, self and others are inseparable oneness. Therefore, the purpose of applying systems thinking is not to depict the details of the component systems, and the relationships among the major and minor systems. It is to frame and reframe our own problems by situating ourselves within the systems which we intend to understand and interpret. Meanwhile, his systems language translates complexity of reality into simplicity of wisdom, with which we could better identify the structural and rooted problems embedded in our own thinking and action. Systems archetypes become powerful tools for converting complicated problems or systems

into simple communicable language. In addition, Senge's systems thinking is intended to be practiced with other disciplines, personal mastery, mental models, team learning, and shared visions. All of the five disciplines cannot be cultivated in isolation. Through the mutual cultivation of the five disciplines, each discipline can exert its greatest learning impact on the team or organization. The five disciplines have been widely recognized and successfully practiced in many organizations. It is time for us to think about its value to education.

In the past decades, educational technologists' visions of systems thinking have been narrowed down to systematic ways of design. We should expand our thinking and discussion about the true nature of systems thinking, and allow more multiple perspectives on systems thinking to enrich our visions. We have focused too much on defining the outer educational systems, ignoring the inner systems within which most of us are prisoned. We may need to start thinking about how to bridge our inner thinking systems with the outer systems through Senge's cultivation of shared visions, team learning and reconstruction of mental models. It is significant to situate all learners, teachers and designers in the boundless circle of the educational systems. We should also learn to live with the fuzziness of system boundaries, which might have seriously distorted our perspectives of systems. If more and more designers could integrate the systems thinking proposed by Banathy and Senge into their practice, design will no longer be treated as models or theories to be applied. When the design community becomes more concerned about ways of expanding design visions and cultivating design thinking, design culture could be possibly fostered. Below is the comparison and synthesis of Senge's and Banathy's systems thinking.

Table 1: Comparison of Banathy's and Senge's systems thinking

The 1st generation Designer	* enters a system as an outside expert * creates an image of the future system * hands it over to the clients for implementation
The 2nd generation designer	* has slightly more interaction with clients * asks clients for feedback on the final draft before turning it over to them for implementation
The 3rd generation designer	* enters an organization as outside expert * draws up plans for the design or redesign of a system with even more interaction with clients. * invites input and feedback from the clients throughout the design process and may even assist them with the implementation.
The 4th generation designer	* takes a radically different role in the design process * functions primarily as a learning facilitator to help clients learn to design for themselves * shifts primary responsibility for learing and designing to the clients * shoulders responsibility for fostering participants' design competence * "does with" the clients, instead of "does to" or "does for" the clients

Lookforward—the design-within approach

Indeed, no matter whether design is a problem-solving, problem-reframing, or dialogical process, we need to be aware if we are doing design in the mode of "reflection in action" or in our original habitual thinking, acting and ways of design. We also need to cultivate our critical awareness and understanding of the essence of design thinking and systems thinking. Especially when design in a team or organization, we need more space to allow one another to navigate so that design visions can be shared, and one's beliefs, values and mental models can be transformed through team learning. It is through the cultivation of design thinking and systems thinking in a learning team and organization that design culture could gradually be fostered. After reviewing and critiquing the essence of design thinking and systems thinking in the previous passages, I would like to propose a new approach of design—design WITHIN to elaborate on the possibilities of fostering a design culture. By taking the design-within approach, the user-designers could be engaged in the design process through which their thinking about design and systems are undergoing inner revolution. Such inner revolution will be dynamically interacting with the outer learning, instructional and educational transformation.

A design philosophy arises from inner revolution

To cultivate our inner revolution, we should hold a truly holistic, systemic view of their inner system and relate our inner systems with outer systems, and furthermore, resolving the boundary existing in between. Such systems thinking aims not at depicting individuals' and organizations' recurrent behavioral structure, but at integrating one's inner systems and outer learning and educational systems. Such systems thinking is to be cultivated through nurturing our inner systems which encompasses awareness, insights and visions. To nurture the growth of such inner system, we could take efforts through the following 3 tasks:

1. **Arousing our AWARENESS of**
- our design thinking & action patterns/structures
- personal and collective design thinking & action patterns/structures
- the embedded causal links in our design thinking & action,

2. **Deepening our INSIGHTS of**
- the multiple relationships of self, others, world and universe·
- the multiple relationships of cause and effect
- complexity and uncertainties of human world

3. **Cultivating our VISIONS of**
- integrating self with others through mutual growth
- transcending personal limitation, & vicious causal links
- tracing the pattern and strucure of problems

When engaged in building a design-within culture, the user-designers will not first define their design product or determine their design strategies. Instead, they will look inwardly through individual and collective reflection to nurture their systemic visions, insights, will and awareness of design. By doing so, uncovering one's design belief, value and philosophy would become the priority of design action. The design goals will shift from enhancing effectiveness and efficient to deepening design participants' visions, insights, will and awareness. In other words, the design-within approach identifies problems as those arising from one's inner systems which are intertwined with and inseparable from the problems we point outwardly to. The design-within approach is concerned with how our design might be influenced by our inner systems, and how we might reconceptualize our views of self and others, designers and users. When we view self and others, designers and users as oneness, we could approach design-within from a truly systemic spirit. Such systemic spirit would better engage us in crystallizing our ingrained design beliefs, values and philosophies. Through such crystallization, we could leap out from our habitual design thinking and action patterns.

Interconnectedness of inner and outer systems dynamics

Indeed, design-within is humanistic-based oriented toward one's inner realization, rather than product-based or goal-based. Design-within is an approach which extends from inner systems to outer learning systems, and arrows from the outer learning systems back to our inner systems. It focuses on the ongoing system dynamics among our inner systems, outer systems and inter-systems. It is through such inner-outer-inter systems dynamics that users and designers, or the so-called user-designers, might cultivate truly systemic thinking, and integrate with one another as an interconnected design community. If designers and users could collaborate with one another beyond the level of information and knowledge sharing, and engage themselves in such inner revolution and systems dynamics, transforming our design mindsets and the reality might be possible. While engaged in the design-within

process, users and designers probe their philosophy and values of design in reflective dialogue, and gradually cultivate their design-within thinking. Through such thought engagement, an interactive process from outward to inward, from inward to outward will be integrated. This might foster our design thinking and action with truly systemic spirit so as to take the responsibility for caring the whole, rather than improving parts of the system.

It is very likely that user-designers could leap out from the existing systems if their inner growth is taken into serious consideration. Because the design-within approach aims at collective and dialogical engagement of all participant's inner revolution. It focuses not on methods, tools, or models to create products, but on methods, tools and models to engage all participants in the systemic thinking process and in the inner revolution process. Its ultimate goal is to transform the existing inner and outer systems. I contend that when our design thinking is no longer locked in product-oriented design, we might foresee the magnificence of design art. The design-within approach is to explore the alternative design possibilities for transforming both inner and outer world. It is feedward from and feedback to the inner systems which are integrated with any outer systems we attempt to design.

The roles of designers in the design-within approach

Before elaborating on what roles the designers in the "WITHIN" approach might play, it is helpful to understand how Banathy compare the roles designers might play in different modes of design. The following table is a brief summary of Banathy's comparison of the evolutionary roles of designers.

The 1st generation Designer	* enters a system as an outside expert * creates an image of the future system * hands it over to the clients for implementation
The 2nd generation designer	* has slightly more interaction with clients * asks clients for feedback on the final draft before turning it over to them for implementation
The 3rd generation designer	* enters an organization as outside expert * draws up plans for the design or redesign of a system with even more interaction with clients. * invites input and feedback from the clients throughout the design process and may even assist them with the implementation.
The 4th generation designer	* takes a radically different role in the design process * functions primarily as a learning facilitator to help clients learn to design for themselves * shifts primary responsibility for learing and designing to the clients * shoulders responsibility for fostering participants' design competence * "does with" the clients, instead of "does to" or "does for" the clients

New roles of designers--Visioning designers

Compared to the four generations of design which focus on "design to", "design by", "design for", and "design with" respectively, the design-within approach places emphasis on all design participants' engagement in design "WITHIN". It is a thought-engagement and action-engagement process undertaken either individually or colllectively. Its systemic spirit builds on the integration of our inner systems into the outer systems, and the inter-systems. It is such holistic system dynamics that designers, users and all design participants are engaged in the design process as "visioning" teams or design communities, rather than "visible" teams or design communities. Through such visioning design teams or community, both inner revolution and societal revolution could be fostered. Designers of this approach share some similarities with the 4th generation designers. They also play as learning facilitators to help clients learn to design for themselves. While the responsibility they need to take is fostering participants' design competence, the responsibility for learning and designing is shifted to the clients. Despite these similarities, they would play other significant roles which the 4th generation designers may even be unaware of. Below are the different roles they would play:

- enters the design systems by treating themselves, other design participants and the social systems as "systemic oneness"
- cultivates all design participants' inner growth and mutual growth
- engages all design participants in reflective and critical thinking of their habitual thinking and action about design
- functions as learning enablers by transforming design into an inner and societal learning process
- shifts design focus from design product to design process to "design mind", a truly humanistic-based design

In one word, the design-within approach focuses on cultivating one's mind for design. It is truly systemic design in which learning and design comes to be oneness, everyone is working toward oneness of the whole system. Oneness becomes the philosophical foundation for constructing an integrated design team or community. Through such integration, design product and process can be greatly enriched and all participants' awareness, vision, insights and will of transforming reality by design can be nurtured and cultivated.

Conclusion

The knowledge base of instructional design models and theories encompasses behaviorism, neo-behaviorism, cognitivism, constructivism, situated theory, and even thinking from critical theory and postmodernism. It also integrates various views and concepts of learning, knowledge and systems thinking. Along with the evolution of design's knowledge base, the roles instructional designers play also change. When instructional designers work as an outside consultant, their role is to design for the users, working at best as the partners of subject matter experts, or the design experts of instructional materials or activities. When constructivism and situated learning gain more attention, instructional designers are expected to design with more comprehensive and timely understanding of the users' needs and feedback. They are also expected to create rich environments and situations for the users' learning, reflection and action (Streible, 1991). When embracing the critical paradigm of thinking, instructional designers' responsibility is to empower the learners' critical awareness of their own thinking and action so that learners are enabled to design their own learning (Li, 1993). In reviewing the evolutionary trend of instructional design, I found that different orientations of instructional design imply different design philosophies of and approaches to design. Although the previous research efforts have consolidated the knowledge base of instructional design to a certain degree, the essence of instructional design is yet to be fully explored. It is not until the early 1990s that the nature of design thinking and systems thinking receives more attention in the field of instructional technology; and more scholars share with the vision of transforming reality by design. As instructional designers, we need to leap out from our technical mode of thinking and acting. We need systemic change in the way we think and act about learning so as to foster our inner and social revolution. Most important of all, we need to cultivate strong willingness to redefine our roles as teachers, learners or designers. We should learn to be more responsible for our own learning, and resume the responsibility to design our own learning in the forthcoming learning world.

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Rapid Application Development of a Self-Paced Pre-Service Teacher Technology Course

Linda Lohr
Manisha Javeri
Chris Mahoney
Dawn Strongin
James Gall
University of Northern Colorado

Abstract

This research examines the feasibility of rapid application development (RAD) in the design of two undergraduate pre-service teacher technology courses. The study was conducted over a three-semester period during which a needs assessment was conducted; eleven units of instruction were prototyped, tested, modified, retested; and the course was fully implemented. The total number of participants included 570 students, six instructional designers/teaching assistants, one lead designer, and four lab assistants. Results of the study showed significant differences in usability scores between the second and third semester. Both positive and negative experiences with RAD are discussed.

Introduction

With technology changing rapidly, instruction on its use must change rapidly as well. Instructional designers are thus increasingly dependent on the use of rapid application development (RAD) procedures for producing timely instruction related to technology use. In recent years, the use of self-paced instruction in the educational environment has been gaining popularity for teaching technology skills. A growing number of self-paced instructional formats are now readily available including books, tutorials, and video series, to name a few. The benefits of self-paced instruction reach an increasingly larger audience as more people take part in distance learning environments, which may in whole or in part employ self-paced features. Despite the benefits, research shows that there remains a stigma surrounding teaching a course via a 'distance' format (Betts, 1998). Further investigation shows that much of this reticence comes from the initial, up-front time investment and the work involved by the person(s) designing and teaching the course (Wollcott & Betts, 1999, p. 35-6).

In these diverse, fast-paced, and quickly changing educational settings, the use of RAD procedures in creating highly usable self-paced instruction is advantageous. How then do we implement RAD for self-paced instruction, and how do we make the self-paced instruction effective, efficient, and appealing, and how do we do that in short order? This study addresses these overarching questions.

Review of the Literature

In the 1960s, the personalized system of instruction (PSI) method of self-paced instruction was developed by Fred Keller [Keller & Sherman, (1982)]. PSI was designed and tested to address researchers' concerns that teaching was primarily focused on the teachers both actively, and passively presenting information to a passive, and at times somnolent, student. According to Sherman (1992), this type of teaching tends to neglect what and how the student learns. It also assumes that the student, as a passive learner, will one way or another receive and understand the information simply because the information has been presented. Teaching styles during that time also encouraged negative reinforcement as behavior/learning modification. Sherman goes on to state that, "if a high frequency of behavior is to be encouraged so that progress can be selectively rewarded, punishing errors is the wrong way to go about it" (p.59). Both PSI and self-paced instruction address these concerns.

According to Kemp, Morrison, & Ross (1998), PSI is also often referred to as "the Keller Plan" and is often used when planning and implementing a whole course of instruction. At the time of its inception, this method was based on the use of a textbook, with assigned readings, followed by questions and problem solving. With the advent of microcomputers and especially when these are connected to the Internet, the Keller Plan can be more creatively applied—often with dramatically positive results.

Self-paced instruction has long been used to teach computer applications such as word processing, spreadsheets, MS Power Point, etc. Technology, however, is changing so rapidly that it often requires frequent

updates to training materials. Unfortunately, self-paced materials are time consuming to produce and thus present a developmental challenge in a dynamic technological world. Even though the designing of self-paced instruction brings with it several unique challenges, there are several advantages to self-paced instruction that make it worth of the time expended in development (Hannifin & Peck, 1987). Most importantly, self-paced formats allow individuals to progress though the material at their own rate. In the classroom environment frees the teacher to help those students who need augmented and/or more ancillary instruction. In both the classroom, and the distance-learning environments, self-paced instruction allows the learners to access the material at times that fit their individual schedules.

It is common practice for software development environments to follow RAD models in creating their software products (Galitz, 1997). Although research has been conducted on self-paced instruction, there is little specific research on the development of self-paced instruction using RAD procedures in academic environments.

Rapid application development is a term used to describe production of software and training products in a series of development cycles that move quickly from initial prototypes to a fully developed product. In these scenarios a prototype of the software is quickly created, tested for usability, and then revised. This cycle is repeated until the final product has been developed. Reigeluth & Nelson (1997) describe a RAD approach in an emerging paradigm of instructional systems design (ISD) they call ASEC (Analysis, Synthesis, Evaluation, and Change). Design and development phases move through an "iterative series of ASEC cycles for progressive sets of instructional decisions" (Reigeluth & Nelson, 1997, p. 31).

The ASEC process allows a designer/developer to focus on how a learner or user responds to instruction as it is being developed. The Evaluation Step in the ASEC process allows for this type of learner/user feedback, (important to learning more about the usability or learner-friendliness of the product). "User-friendly" is a term that describes how technically easy a product is. "Learner-friendly" describes how easy an instructional product is for a learner to use (Lohr, 2000). The International Standards Organization (ISO) defines usability with the descriptors effectiveness, efficiency, and satisfaction. Lohr (2000) defines usability and learner-friendliness with effectiveness, efficiency, and appeal, based on similar definitions by other design researchers (Flagg, 1990; Nielson, 1993; Shackel, 1991; Tessmer, 1993) .

Research Questions

This study focuses on the development of self-paced pre-service teacher technology training using a RAD approach. Research questions include:

1. How usable was the instruction from student, instructional designer/Teaching Assistant (ID/TA), lead designer, and lab assistant perspectives?
2. Did usability perceptions change during the RAD process?
3. What are the advantages and disadvantages of using a RAD process in an academic setting?

Methodology

Participants

This research was conducted at a medium-sized Western university and involved 570 pre-service teachers enrolled in two levels of technology-integration courses. Other participants in the study included six instructional designers/teaching assistants (IDs/TAs), a lead instructional designer, and four lab assistants. Out of 657 total students enrolled in both 200-level, and 300-level levels during the two semesters, a total of 570 students participated in the study. Of the 570 students who filled out the surveys, 316 students were from the 200-level classes and 254 students from 300-level classes (described later in this paper). At the end of each semester, four students from each class were randomly selected to be interviewed (a total of 118).

Course Description

Two one-hour pre-service teacher technology courses were developed for this study, referred to as the 200-level and 300-level courses. The 200-level course was an introduction to technology for freshmen or sophomores. The 300-level course was a more advanced course for juniors and seniors. In both courses combined, there were a total of 11 units of instructions to be created. The topics included, email, uses of the World Wide Web (WWW), and word processing.

All sections were taught in three formats: workshops, open-labs, and via self-paced instruction. The three formats broke down as follows: The workshops consisted of instruction, both verbal and visual, where each project was completed in front of the students. In this format many of the students could follow along step by step. The open

labs were set up so that any student could get individual instruction. For the aspects of each project where a number of students were struggling over the same component, this was noted so that it could be addressed in a redesign between semesters. The lab assistants were also present during open labs to help students one-on-one with their individual difficulties. The self-paced instruction was taught via the web sites set up for each of the two courses. Every student was required to have an e-mail account and access to the Internet. The students could access the 200-level and 300-level web sites where all the 11 units of instruction were hosted. To view these units of instruction, visit these Web sites; www.edtech.unco.edu/et34x/ and www.edtech.unco.edu/et24x/.

Procedures

The study was conducted over three semesters (Spring of 1999, Fall of 1999 and Fpring of 2000). The topic covered as well as the formats of instruction were gleaned from a pre-service teacher needs assessment conducted in the spring semester of 1999. Three students (pre-service teachers), three graduate-level teaching assistants, and one faculty member were interviewed about the effectiveness, efficiency, and appeal of the undergraduate pre-service teacher technology courses at that time. These interviews revealed the following: a) there existed a lack of instructional consistency in courses (different instructors teaching different topic in different ways); b) the instructional materials were outdated; c) students came to the class with different proficiency levels ranging from computer illiterate to highly skilled computer users, but all students were expected to learn at the same pace; d) students were required to attend all classes even if they knew, and were proficient with, the software being taught; e) many students had scheduling conflicts that could have been prevented with the implementation of a self-paced format.

The needs assessment team identified self-paced instruction as a possible solution to these issues, since SPI not only allows for learners to progress at their own pace, but allows for greater standardization of the instructional content as well.

Beginning with the fall semester of 1999, a team of three teaching assistants (TA's) and a lead instructional designer (ID) planned the development and implementation of RAD to the instructional material needed for the courses. The team met weekly intervals to plan and review their work, discuss problems, concerns, and progress. The team also kept a record of their observations. The actual RAD course development was performed throughout the first semester, but a revising process (implementing feedback from the first semesters' participants) continued between the semesters as well. Each of the teaching assistants developed approximately one-third of the total units of instruction.

Every week each of the developed units of instruction would be presented to the team members who would collectively review what each TA had designed, test the instruction, and make suggestions. At this time the lead ID would also make suggestions. After this open-forum-type of critiquing was finished, the TA in charge of each unit of instruction would make the necessary revisions, test it, and then re-present it to the group the following week where the rest of the team members would again review the TA's work, usability test the unit of instruction, and give their final suggestions. The TA would then make any necessary final revisions, transfer the finalized unit of instruction to the course web site for those who were doing the course via self-paced instruction, and the instructor would also present it to the class as an in-class instruction module. This process of designing, developing, open-forum critiquing, revising, and usability testing was followed for each of the 11 units of instructions. Thus, every two weeks and within a two-week span, the RAD model was used with two individual units of instruction.

Instruments

Quantitative and qualitative data were collected from the following sources: students participating in the course; teaching assistants, all of whom not only taught the course, but also monitored the lab sessions, and some of whom (instructional designers) also helped design the course; the lead instructional designer who managed the design and development process, and the lab assistants who interacted with the students while the students participated in the instruction. Both the lead instructional designer and the IDs/TAs kept journals for a 12-week period. Lab assitants were informally interviewed. Qualitative student data was obtained using 16 open-ended questions included in an end-of-the-semester questionnaire, from 120 student observations, and from 118 student interviews.

All qualitative data were transcribed, and thoroughly read and re-read. Different colored markers were used to highlight words and statements which fell into the three main research categories: effectiveness, efficiency, and appeal. An overall theme and sub- were then identified for each category.

Quantitative data were collected using 43 Likert-type items included in an end-of-the-semester questionnaire. The five-point Likert scale ranged from "strongly disagree" to "strongly agree." The items were created for each of the three main domain areas: effectiveness, efficiency, and appeal. Factor analysis was used to

verify the structure of the above mentioned survey questionnaire. A structure matrix of a three-factor oblique rotation (Kappa = 4) of a principle-components solution was found. The factors were learning and educational value (effectiveness), resources (efficiency), and self-paced instruction (appeal). Problematic items i.e., loaded on two factors or demonstrated a factor loading under .30 on any factor, were not used as part of the composite scores. Item analysis within each factor demonstrated strong reliability, and hence stability of the survey as a whole. Reliability coefficients for the 200-level courses were found to be $\alpha_{effective} = 0.9301$, $\alpha_{efficiency} = 0.8071$ and $\alpha_{appeal} = 0.8070$ respectively. Reliability coefficients for the 300-level courses were found to be $\alpha_{effective} = 0.9121$, $\alpha_{efficiency} = 0.7270$ and $\alpha_{appeal} = 0.8775$ respectively. The final composition of the domains suggest a degree of validity.

Results

Students perceptions of usability

Effectiveness

Qualitative analysis of the randomly selected interviews and open-ended questions found a strong majority of positive responses from students related to the effectiveness of the course. Students mentioned liking the course for a variety of reasons that were categorized as educational and learning value. Data were coded into the following sub-themes: content learned was applicable to the classroom; knowledge was gained; portfolios were developed; topics could be freely chosen; projects were relevant; the overall format was convenient; he experience was isolating and often not challenging enough. Most of the positive comments from both levels were associated with how precise the instruction was and how useful it would be in a classroom. Most of the negative comments were associated with dislike for specific topics that were considered repetitive (ASSURE), too difficult (Photoshop), or too easy (email). The most common statements used by students were as follows: "I learned a lot in this class."; "I gained more knowledge, new ideas, and ways to use technology."; and, "I feel comfortable with technology." All of the students randomly selected to perform a task representing the semester's work performed satisfactorily. All of these same students felt the textbooks were a "waste of time".

Quantitative data for effectiveness was calculated by averaging the percentage of agree and strongly agree scores for fall and spring semester for each course level on specific questions. Quantitative results were similar to qualitative results with a strong majority of students (86% of fall and spring 200-level and 72% of the fall and spring 300-level) agreeing or strongly agreeing that the course was educationally valuable. Eighty nine percent of the 200-level and 72% of the 300- level agreed or strongly agreed that skills learned were important. Fewer students indicated they learned a lot (61% of the 200-level, 69% of the 300-level). As indicated by the qualitative data as well, both levels felt that the instruction, given both in-class and on-line, was precise and clear. These students indicated that they would use the technological skills learned during this course both in their future classrooms for instructional delivery, and for their own personal classroom management use and gains. They stated that this usage would include programs like PowerPoint (200-level) and Web design (300-level, also suggested as a way to gain employment) and incorporate the design and graphics knowledge they had learned. These students indicated that the course helped them not only learn skills with which they were previously unfamiliar, but also to learn how to integrate technology into their classrooms. At the end of the course, a majority of students felt very comfortable with technology

Efficiency

In the Qualitative analysis the *Value of resources in terms of access and ease of use* emerged as the key theme or descriptor for questions related to efficiency. Data were coded, then grouped into these sub-themes: online materials, open labs, workshops, instructors and lab-consultants. Two-hundred-level and 300-level students were most positive about having a choice of learning format (workshop, open-lab, or self-paced), and most negative about specific projects and isolation. The 300-level group felt strongly that they had too much work to do for a one-credit course. Of those who were interviewed that did not like the course, two main reasons were given. Some mentioned they did not like the self-paced format because of isolation and problems with self-discipline. Others mentioned they didn't believe the technology would be available to them in the classroom. All students felt the textbooks were not helpful. Half of the students in the first semester wanted more project examples when interviewed at the end of the fall semester. Surprisingly just a little under a half of the students interviewed in the spring still indicated the need for more examples (despite the development of examples and non-examples for each unit of instruction that took place during the spring semester).

Typical comments during student interviews included: "The on-line materials were precise and easy to understand because of the step by step instructions"; "The rubrics/or grading criteria were too easy"; "I would like to see more examples of finished projects" ;"PhotoShop was too confusing"; "In open-labs I could get personal attention and help to complete my projects";" Workshops were very helpful for difficult projects like PhotoShop, Web design and PowerPoint"; "The instructors were very approachable, accessible and always available to help me"; "The instructors were knowledgeable.";"The lab consultants were there to help me when I got stuck."

Quantitative data for efficiency was calculated by averaging the percentage of agree and strongly agree scores for fall and spring semester for each course level on specific questions. Quantitative data was similar to qualitative with a higher percentage of neutral responses and a lower percentage of responses in the agree and strongly agree categories. Approximately 60% of the 200-level responses were positive about both the instructors and the self-paced instruction. Approximately 75% of the 300-level responses were positive about the instructors and the self-paced instruction. Open labs and workshops received lower scores, with less than half of the 200-level students positive about either format. The data was similar for the 300-level who had a slightly higher percentage of agree or strongly agree responses (59% for workshops and 55% for open-labs.) Of particular interest is that only 58% of the 200-level and 59% of the 300-level felt they had enough self-discipline for the self-paced format.

Appeal

Of the three usability variables, appeal had the most positive student responses. Quantitative data related to appeal was more positive than the qualitative data regarding overall course appeal. From the qualitative data, a a strong majority of students interviewed mentioned liking the self-paced nature of the course. Not surprisingly, the key theme that emerged from the questions was a positive regard for the self-paced format. Self-paced thus emerged as a key descriptor for appeal based on data that was coded then grouped into following sub-themes: freedom, self-discipline, convenience, isolation, and not challenging. Both levels of students mentioned the self-paced format gave them the freedom and flexibility to go at their own rate and, hence, made them feel less pressured and felt they had a lower stress level than if they had taken the course via a traditional in-class format. The self-paced format was particularly helpful for the students who already knew most of the tools. The self-paced format also required students to apply better time-management skills. Again, some students did not like the self-paced because they felt the format lacked student/teacher interaction as well as class-related communication with fellow classmates. Typical comments included: "I liked the option to attend workshops open labs or follow self-paced for projects that I was comfortable with"; "It was nice to know that help was available whenever required"; "I learned to manage time effectively"; "I sometimes tended to procrastinate my work"; "I liked the convenience of working at my own time and pace"; "I liked the fact that I did not have to come to the class if I knew the project"; "The fact that I did not meet officially made me feel isolated"; "Projects like word, e-mail, WWW were too simple and basic"; "I knew most of the software and hence was hard to stay motivated."

Quantitative data for appeal was calculated by averaging the percentage of agree and strongly agree scores for fall and spring semester for each course level for specific questions. Results related to appeal were quite high for both the 200 and 300 level students. Approximately 90 % of the students agreed or strongly agreed to statements regarding the overall usefulness of self-paced instruction. For example 97% of 200-level students and 89% of 300 level students indicated liking self-paced instruction. Ninety five percent of the 200-level students and 89% of the 300-level students indicated the self-paced instruction was helpful.

Teaching Assistants/Instructional Designers

The instructional designer/teaching assistants were asked to keep a journal during the fall semester to record two types of information: 1) student behaviors and attitudes, and 2) issues relating to the format and accuracy of instruction. Perceived effectiveness, efficiency, and appeal data were categorized and grouped. Observations related to the effectiveness of the course included noticing that students were often copying the assignment example instead of generating their own solutions, and were not checking the Web site bulletin board. Observations related to the efficiency included the lack of student attendance at workshops. For example, students would elect the self-paced format, wait until the last minute, and then discover they could not do the assignment without help. Observations related to appeal included reports that many students were unhappy with scheduling issues. These students said the classes did not meet during convenient times.

Several actions were taken immediately prior to the next semester to address these issues: 1) the free-for-all schedule was eliminated requiring students to sign up for a class at a specified time; 2) students were required to attend workshops unless they had turned in the self-paced instruction; and 3) class listserves were used as a communication vehicle in addition to the message board. During the following semester these problems were not

mentioned by the students. One issue however that remained a problem was the need for the Web site to provide more and varied project examples since students continued to turn in assignments very similar to the examples used.

Lab Assistants

The lab assistant interviews indicated mostly problems with efficiency and effectiveness. Lab assistants described themselves as being bombarded the day an assignment was due. These students felt that they had to teach students how to do their projects. The interviews revealed that over half of the lab assistants did not know about the self-paced materials or where they could be located. Those who did know indicated that most of the students did not have the web-site address easily accessible. Lab assistants addressed this problem by writing the class website on lab whiteboard. The one problem identified in the Spring semester interviews with lab assistants was the difficulty students were still experiencing with the Web site URL. Therefore in the third semester of the project, the web site was given a new and simpler URL, and desktop Web site icons were created to allow students to access the site by clicking the icon instead of typing in a lengthy url (http://www.edtech.unco.edu/et34x/def34x.html).

The Lead Instructional Designer

The Analysis, Synthesis, Evaluation, and Change interpretation of RAD was documented and evaluated on a weekly basis by the lead designer to determine overall effectiveness of the RAD approach. Time spent, management issues, technical issues, and student behaviors were noted for all eleven cycles of development during the fall semester. Of each of the steps, the lead designer was most disappointed in the inability to implement learner testing in the Evaluation step. Lack of time prevented the IDs to involve students in the development of the instruction. Therefore the learner-testing phase was actually a design-team testing phase. The process however seemed adequately effective even without student involvement in the two-week testing phase. The units of instruction were delivered on time with few errors.

The efficiency of the RAD process was assessed in part by recording time-spent on specific activites. The lead designer was not prepared for the amount of time it took to set up the course templates and create master schedules for open labs and workshops to accommodate student schedules. Three full days were spent working on the schedule alone. These cycles included a brief analysis step (identification of a specific task and content needed), development of instruction (seven hours), testing by the team (1 - 2 hours), revision and Web posting by the designer (8 hours), team re-testing and revision, changes (3 hours), and implementation. The lead designer also regretted her decision to use Microsoft Word as the Web-site authoring tool because it was less stable on the server than were other Web authoring programs. Microsoft Word was chosen because most IDs/TAs were not proficient with Web authoring and needed a very simple tool. Unfortunately this backfired with numerous server problems that took up an additional four hours per week to address.

The more interesting aspect of the appeal data relate to the RAD process came from the lead designer's observations of ID's/TA's gradual acceptance of both the format of instruction and the RAD process. Early in the first semester students were highly frustrated with the process of rapid development. They were unfamiliar with the precision self-paced instruction required as well as the demand for user-friendly writing. Combined with low workshop and open lab attendance during the first few weeks of the semester, these TA/IDs were openly frustrated. By the middle of the semester they voiced extreme dissatisfaction with the process and structure. During the second half of the semester they gradually gained more acceptance of the format and showed interest in making improvements. Also noted was their improved ability to write learner-friendly instruction.

Change In Usability Between Semesters

Lead designer, TAs/IDs, and lab assistants all noticed improvement in the course during the Spring semester. These observations are in part supported by multivariate analysis of variance (MANOVA) results. A MANOVA was used to investigate differences between the fall 1999 and spring 2000 semesters with respect to the factors: effectiveness, efficiency and appeal. Significant MANOVA results were followed by discriminate analysis. A significant difference was found in the ET 200-level data between the fall of 1999 and the spring of 2000 semesters (F (3,301) = 8.356, $p<0.00$, Wilks' lambda=0.923). A stepwise discriminate analysis was used to determine if there was a specific variable contributing the strongest influence to this difference. It was found that only the resources factor -- efficiency -- (e.g., workshops, open labs, and self-paced instruction) that contributed most to a change between semesters (F (1,303) = 22.11, $p<0.00$).

In comparing the fall and spring ET 300-level courses, significant differences in all three factors (F (3,240) = 19.702, $p < 0.00$, Wilks' lambda = 0.802) were found. A stepwise discriminate analysis was used to determine if there was a specific factor contributing the strongest influence to this difference. This analysis indicated that all the three dependent variables were equally responsible for the differences between fall of 1999 and the spring of 2000

semesters. The stepwise discriminate analysis showed that Appeal made the biggest difference among semesters (F=45.568, Wilks' Lambda=.955). Appeal was followed by Effectiveness (F=41.426, Wilks' Lamda = .941). Efficiency made the smallest difference among semesters (F = 8.18, Wilks' Samda = .831).

Discussion

That significant differences were found in usability perceptions between the second and third semesters might suggest that RAD played a role in improving instruction. Changes to instruction were made based on data gathered during the semester. For example clarifications in assignments, additional examples, the correction of errors, all improved the quality of the experience. Many of the concerns and complaints expressed by TAs and students alike during the first semester were not voiced during the second semester.

There are however, many possible reasons for the significant differences that took place between the second and third semester that may not be attributable to RAD. A more positive or motivated group of students may have been enrolled in the second semester. TAs may have conveyed more confidence, thereby influencing the attitudes of the students for a variety of reasons. Most obvious would be that the materials were already developed and error-free, therefore TAs had more time to devote to individual students, and were also more confident that fewer mistakes would cause student confusion. The simple change in required scheduling had perhaps the biggest impact as many students were dissatisfied with the open schedule format of the first semester. This schedule change was not a function of RAD.

The key benefits of RAD in this study appears to be improved instruction that lasts for a longer period of time. There has been much cited in the research about the low return on investment of self-paced instruction (Wolcott & Betts, 1999). Initially, in this study, that was the case as well; however, because the course content has remained fairly stable over the past year and a half, the time expenditure has been amortized very effectively. As this article is being written (halfway through the third semester after the RAD took place) the researchers have found that the time expended for evaluation and revision have been substantially less than if the courses were being taught via a more traditional format. For the spring 2000 semester, approximately a week was spend in completing a cursory analysis of the data from the previous semester's surveys; in reevaluating the course philosophies and content in light of the surveys; and in revising the Websites, syllabi, rubrics, and schedules. In the summer semester, there were no changes made other than changing the dates and times on both the syllabi and the course schedule, which took approximately two hours for both courses. In the fall 2000 semester, a total of approximately two days was spent in the review, analysis, and revision process. All told, for two different courses that serve so many students, this time expenditure is quite modest.

The key drawback of RAD in this study was the need to act quickly. In this study hasty decisions had long-lasting ramifications. When the study began, the lead ID drew up the original course outline and even created the initial Website shell for the courses using a very simple authoring tool, Microsoft Word. This was done because the TA/IDs had little experience with developing Web based instruction and would need a familiar and easy development tool. Because the Lead ID did not want application specific ramp-up time to impede the IDs progress, it was decided that templates could be created and used. Because Microsoft Word is a fairly basic web-authoring tool the software became a limiting factor once the demands of the site require more complexity. The team recommends beginning with a more robust web-authoring software capable of accommodating a broader range of Web site maintenance tasks, such as frequent revisions to instruction and use of different browsers and Web editors.

Also of interest to future RAD projects in academic environments is the effect the approach has on novice instructional designers. Because rapid application development is just that, rapid, it brings with it a set of dynamics with which most academic settings are not usually confronted. In this study, the lead ID had been through this type of development numerous times and, as a result, was mentally prepared for the frustration that is typically a part of the designing, developing, open-forum critiquing, revising, and usability testing process. Individual and team frustration is so inherent in the RAD model that it can almost be mapped out and defined as part of the cycle. In this study's cycle, the TA/IDs became quite frustrated with the intensity and seeming lack of progress early on. However, as the process continued and the fresh, never-tried-before units of instruction were introduced to the students they seamlessly learned the material and skills and produced the hoped-for and required results. The TA/IDs then began to more clearly understand how RAD works, and as a result, became much more enthusiastic about its application and results.

Conclusion

Overall, quantitative and qualitative data collected from students, TAs/IDs, the lead ID, and lab assistants suggest that the course was learner-friendly. The data identified areas for improvement as well as areas where students were highly satisfied with the quality of instruction in both the 200-level and 300-level courses. The

importance of providing instruction that is neither too easy or too difficult was identified, as both were mentioned as negative aspects of the course. The need to help students think creatively and find ways to use the tool for their unique instructional purposes must be improved, perhaps through many and varied examples and non-examples. Scheduling problems and difficult Web site access negatively influenced student's perceptions of efficiency and appeal. The self-paced format, however, was considered highly appealing. Though many students considered themselves self-disciplined, the data suggested the need to implement a structure for students that imposed due dates, designated class times, and the requirement to have self-paced instruction completed prior to a workshop.

Although RAD has found an almost hallowed place in fast-paced corporate settings, we were reticent about its usefulness in an academic setting. The results of this study, however, have shown that RAD can be applied quite effectively. The results have shown that in the right application, time-dependant course material can be delivered efficiently, effectively, and in an appealing manner using RAD. The caveat is that all aspects of the process should be well thought out, critiqued, revised, and usability tested.

Several areas of future research related to this topic should be explored. For one, the importance of instructional graphics needs to be examined. Because instructional graphics are so time-consuming to develop, an important consideration is the optimal amount of graphics to include as well as the type of graphics for RAD of self-paced instruction. For example, should graphics show an entire computer screen, or should they display just a button or pull down menu? Additionally, what are the most learner-friendly writing conventions? Is "select Save As from the File pull down menu" as effective as File > Save As? Another more challenging question asks how pre-service teachers can be taught to think creatively when applying technology to their unique instructional management or development goals. The excuse of not needing to learn about technology because one already knows how to use a particular tool isn't valid when the focus is on learning to use the tool to enhance instruction. These questions and many more will provide more insight into learner-friendly development of pre-service teacher technology courses.

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In Support of Constructivism: Utilizing Rational, Moral and Communicative Frameworks to Address Frequently Posited Criticisms

Rocci Luppicini
Heidi Schnackenberg
Concordia University

Abstract

The goal of this paper is to demonstrate how Constructivism in education has failed to address criticisms by re-directing or misdirecting the focus of the debate over whether or not Constructivism is able to give support to a viable theory of instruction. In response, support is given to Constructivism by drawing on rational, moral, and communicative frameworks to clarify the main Constructivist tenets and to address levied criticisms. From this, the recommendation is made that, depending on how they are used, objective standards of learning and evaluation are not problematic for Constructivist instruction.

Constructivism

Constructivism in Education originates with the basic assumption that reality (or its experience) is not separate from but includes participants (regardless of the nature of that participant) in its observations. The same constructs and mutual meaning are construed as a gradual process of accommodation that achieves a relative fit of meaning constructions.

Constructivism concentrates on contextually meaningful experience with the goal of fostering the development of autonomy and social reciprocity. Generally, Constructivism is considered to be a theory of knowledge and learning that concerns itself with what one knows and how it is that one comes to know. This theory derives its views on knowledge from multiple sources (i.e., philosophy, psychology, anthropology, sociology, etc) and considers knowledge to be internally constructed and socially mediated. Learning is viewed as a self-regulatory process involving individual meaning construction and processes of social negotiation through social activity, discourse, and debate (Twoney & Fosnot, 1996).

According to Constructivists, how one constructs knowledge is a function of the prior experiences, mental structures, and beliefs that one uses to interpret objects and events. Constructivism does not preclude the existence of external reality, it merely claims that each of us constructs our own reality of the external world. Thinking is grounded in perception of physical and social experiences, which can only be comprehended by the mind (Jonassen, 1991).

There have been many branches of Constructivist theories put forth. In contemporary Constructivist theory, the strongest individualistic theory of Constructivism comes from von Glaserfeld (von Glaserfeld, 1995; 1996). Von Glaserfeld's "Radical Constructivism" rejects the Objectivist notion that knowledge can be treated as an accurate representation of external things. In contrast the author emphasizes that knowledge be treated as an individual 'mapping of actions and conceptual operations that had proven viable in the knowing subject's experience' (von Glaserfeld, 1996). Under this view, no two people produce the same constructs and mutual meaning is construed as a gradual process of accommodation that achieves a relative fit of meaning constructions.

Spiro, R., Feltovitch, P., Jacobson, M., & Coulson, R. (1991b) offer a very selective version of individualistic Constructivist instruction drawing form their Cognitive Flexibility Theory (Spiro et al., 1987, 1988). This theory attempted to explain learning in ill-structured domains, highlighting the centrality of multiple knowledge representations:

> "Our Constructivist position, as it applies to complex and ill-structured domains, rejects any view that says either that there is no objective reality , or that there is an objective reality that can be captured in any single and absolute way. Rather, one of our principle tenets is that the phenomenon of ill-structured are best thought of as evincing multiple truths: single perspectives are not false , they are inadequate. That is why multiple knowledge representations are so central to Cognitive Flexibility Theory."

Spiro et al. (1992) refer to their general approach as 'Cognitive Flexibility Theory," taking it to be an integrated theory of learning, mental representation, and instruction that focuses on the acquisition of knowledge in ill-structured domains. This approach can be characterized as being critical (addressing deficiencies in learning) and involving multiple perspectives or representations of knowledge (multiple juxtapositions of instructional content).

A second branch of contemporary Constructivism concentrates on the socially and culturally situated nature of learning activity, drawing much of its theoretical basis from Vygotsky (1970; 1979), social activity theorists (Bordieu, 1976; Garrison, 1998: Lave, 1998), Mead, and pragmatism (Rorty, 1978; Putnam, 1987). Garrisons (1996), Meadean approach to Constructivist epistemology emphasizes individual's self-realization being derived from actions in the social world. This view of Constructivism is largely embedded in a social context characterized by argument, discussion and debate. This is described by Cunningham (1991):

"At the heart of Constructivism is the notion that knowledge is constructed, which in the present instance means that our theoretical views are personal creations, embedded in a social context, within a social community that accepts the assumptions underlying the perspective. There is no right or wrong her in any absolute sense. Holding a theoretical perspective means, making a personal commitment to it, while recognizing the potential validity of other positions."

There are also approaches that attempt to combine both individualistic and social approaches to Constructivism. CTGV (1991) view of Constructivism can be described as combining elements of a individual and social learning perspective in an emphasis on the social nature of cognition. Under this view, the individual is free to build his or her own interpretations of the world, so long as the interpretation is coherent with the general zeitgeist. Knowledge is taken to be a dialectic process the essence of which is that individuals have opportunities to test their constructed ideas on others, persuade others of the virtues of their thinking and be persuaded, (CTGV, 1991).

Regardless of the Constructivist theory supported, there are certain fundamental characteristics of Constructivism that can be enumerated. First, there is a general agreement on Constructivists' rejection of the Objectivist framework, which assumes that there are established standards of teaching and evaluation that are known and can be imposed to control learning and assess learning performance. Constructivists oppose objectivity on two main points: (1) they oppose the external control of learning that is imposed independent of learning, and (2) they oppose Objectivists' justification of objective standards of evaluation based on claims of having objective knowledge of the real world. However, this does not mean that all forms of objectivity or objective standards of evaluation have to be rejected (as will be shown).

Second, there is a perceived necessary link between Constructivist instructional theory and practice. In, "Continuing the dialogue", Duffy and Jonassen (1991) hold that behind every good instructional design model there is a theory drawn from experience. They state that , "The models derived from those experiences do not simply reflect instructional strategies and methods--simple behavioral activities. They also reflect an underlying conceptualization of what it means to learn and to understand." What this does is establish a criterion that prevents any external control of learning, while at the same time not exclude theoretical concerns needed for there to be an instructional theory at all.

Many Constructivist authors believe that theories of learning and prescriptions for practice go hand in hand. Duffy and Jonassen (1991) state, "While instructional designers typically may not have the time or support to explicitly apply a theory of learning during a design or development task, the theory is nonetheless an integral part of the instruction that is produced." Thus, learning cannot be assessed on the basis of immediate task performance. Some aspects of learning are not required until much later. It is largely for this reason that there is an emphasis on higher-order learning.

It is also for this reason that there is an emphasis that learning environments should have real-world relevance and that students should be equiped with appropriate levels of complexity (authentic tasks). Learners should actively engage in building complex knowledge structures and this requires higher-order thinking (knowledge construction). Evaluations need to be able to assess higher order thinking well (Gagne, 1987; Merrill 1983). It is seen as more important to evaluate how learners construct knowledge (knowledge acquisition), rather than to evaluate the product (process oriented).

Third, there is a strong prescriptive component that marks a defining feature of the Constructivist approach (Bednar, Duffy, Cunningham, & Jonassen, 1991). This is reflected in how learning and learning assessments are considered to be a continuous, ongoing process, rather than being tied to a specific task performance (Jonassen, 1991, 1992, 1995). Also, Constructivist instruction is directed towards the cultivation and assessment of higher-level learning (Spiro, Feltovitch, Jacobson, & Coulson, 1991, 1992). The prescriptive aspect of Constructivist instruction is valuable because it includes within its approach the assumption that learning and instruction are evolving processes. This is highly supported by those educational scholars who believe in the importance of educational ideals (Searle, 1995; Steffe, 1995).

Objectivist and Constructivist responses to paridigmatic criticism

One pivotal methodological issue for Constructivist theory surrounds the question of how objective knowledge is tto be treated. Given that, terms like "objectivist" and "objectivity" have been used in a multiplicity of ways, it must be clarified how these terms are been employed in the present work.

The present discussion utilizes the general notion of objectivity as the objective view of knowledge derived from general philosophy. The objective view of knowledge asserts that there is a real and structured world for which one can possess reliable knowledge (Putnam, 1994; Reigeluth, 1991). Knowledge obtained from the world is taken as stable and reliable because properties of objects in the world from which knowledge is obtained are assumed to be relatively unchanging. Because knowledge is objective, the meaningfulness of knowledge is external to individuals and therefore can be analyzed and standardized.

The first criticism from Objectivists opposes Constructivist's failure to take pre-existing skills and individual performance outcomes into consideration, based on their evaluation of success being represented by the completion of the learning task (Dick, 1991). Jonassen (1995) discusses the implications of Constructivism for learning and instruction:

> "The principles by which those learning environments may be built focus on four general system attributes: context, construction, collaboration, and conversation. Constructivist environments engage learners in knowledge construction through collaborative activities that embed learning in a meaningful context and through reflection on what has been conversation with other learners ."

Many of the fundamental attributes considered by Constructivist instruction do not start in learning that begins in the discrete learning situation to be considered. Rather, they have been built from previous experience (Dick, 1991; Reigeluth, 1991). According to Objectivists, such attributes as pre-existing knowledge cannot be dismissed. They are a part of, and presupposed by, any Constructivist instruction. There exists some standards due to previous experience, without which, new learning would be inconceivable (Searle, 1981, 1992). Such standards are brought into new learning situations in the form of previous knowledge and skills that have been built through past experience. In the Objectivist view, ignoring this is a serious oversight that plagues Constructivism in education.

A second criticism from Objectivists concerns the Constructivist challenge of assessing learning. If Constructivists do not use performance as an assessment of learning, then how does one know if learning has taken place? Some Constructivists posit that learning is an emergent property, invoking both instructors and participants, that "falls out" of the learning process (Bednar, Cunningham, Duffy, & Perry, 1991; Cobb, 1994; Cobb & Yackel, 1996; Jonassen, 1991). Cobb (1996) argues that researchers have to be included as well due to their interpretive role and perspective in the educational context. Cobb further states that it is social reality that should dictate the theoretical perspective. The author draws on previous classroom research (Cobb & Yackel, 1994) that utilized ongoing student-instructor interactions in conjunction with an inquiry-based instruction and that yielded positive support for learning mathematics. Emergent learning explanations, similar in nature to Cobb's (1996) are becoming increasingly popular as well (Bereiter, 1994; Martin & Sugarman, 1996; Perkins, 1993; Prawat, 1996).

For some, these types of learning explanations are not sufficient. Reigeluth (1991) supports there being a need for some sort of objectivity in contextual performative evaluation. He accounts for the fundamental difference in approach to learning assessment by the fact that these other authors chose to connect instructional theory with learning theory, whereas he treats them as different and maintains the need for there to be a separation.

Unfortunately, the Constructivists' responses do not sufficiently address the above levied criticisms. Most responses do not acknowledge the specific questions, but merely attempt to oppose the Objectivist framework (Bednar, Cunningham, Duffy, & Perry, 1991, Jonassen, 1991, 1994, 1997). Jonassen, Hennon, Ondrusek, Samouilova, and Spaulding (1997) provide opposition to the Objectivist approach to science by utilizing work from hermeneutics (knowledge building through interpretation), fuzzy logic (evaluating from multiple sources and perspectives based on probabilistic and non-linear nature of information), and chaos theory (emphasizing non-predictable nature inherent in systems). Stronger Constructivist responses seek to reject completely the criticisms levied, but more moderate Constructivist responses seek to assimilate other perspectives into their own framework (Cunningham, 1991, 1992). Within this view, objectivity becomes translated into another perspective that can be subsumed and exercised without contradicting other perspectives. This multiple perspectives approach emphasizes the importance of integrating all views in the evaluation process (Jonassen, 1991). By not acknowledging specific questions and by redirecting the focus of existing criticisms made, Constructivist explanations do not address the issues, but merely evade them.

Towards an alternative view of Constructivism

For the most part, Constructivist explanations share a common theoretical grounding in Postmodernist philosophy (Phillips, 1995, 1996; Prawat, 1996). Postmodernist philosophy can be characterized by the breaking of all ties with existing foundational modes of thought and replacing this structure with a relativistic philosophy that embraces multiple frameworks of meaning found in particularistic accounts, (Guba & Lincoln, 1985; Howe, 1988;

Rorty, 1986). Guba and Lincoln (1985) believe there to be no possibility of accomodation between the foundational scientific and Postmodernist paradigms because the basic assumptions of the two are in conflict.

Adherance to a Postmodernist framework is an implicit assumption that runs through numerous Constructivist theories, such as von Glaserfeld's (1990) "radical Constructivism" and the majority of social Constructivist work (Cunningham, 1991, 1992; von Glaserfeld, 1990). Radical Constructivism (1990) holds that there is no objective reality that can be uniformly interpreted by all , while Cunningham's (1991) Social Constructivism calls for the integration of multiple perspective taking to accommodate individuals' differing interpretations. Much of the criticism of Constructivism (Reigeluth, 1991; Dick, 1991) is directed at the lack of objective standards and means of rational legitimization entailed by adopting Postmodernist philosophy.

There are alternatives to Postmodernist philosophy that allow for multiple frameworks of meaning, which characterize Constructivist explanations. Putnam (1990) argues for the possibility of appealing to objective rational standards by demonstrating the need for particular communities and practices to rely on some level of underlying conditions required for evaluative judgements to be made in the Constructivist domain or any other domain. This demonstrates the potential of Constructivism to overcome certain limitations that have been pointed out (Dick, 1991; Reigeluth, 1991).

A more comprehensive view of Constructist instruction can be obtained by examining the cognitive tools available (Kommers, Jonassen, & Mayes, 1992) within a non-Postmodernist perspective (Putnum, 1990; Siegal, 1996). Attempting to theoretically ground cognitive and non-cognitive tools relevant to the Constructivist position will provide a more extensive view essential to providing any serious support to the Constructivist position.

Addressing criticisms to Constructivism by drawing on multiple frameworks

This section deals with criticisms to Constructivism by presenting evidence from areas outside the literature. The literatures drawn from provide innovative ways to defend Constructivism, referred to as tools. These tools are divided in cognitive and non-cognitive types. Cognitive tools refer to individual psychological processes, whereas, non-cognitive tools refer to broader normative acts such as discourse practices.

Theoretically grounding cognitive tools in support of Constructivism

In *Rationality Redeemed?,* Siegel (1996) introduces his theory as a continuation of longstanding efforts to demonstrate that rationality possesses an "educational cognate" in critical thinking (Barnes, 1992), which represents an educational ideal. This work stems partly from an effort to address anti-Enlightenment tenets present in philosophy of education. It acts as both a response to existing arguments and as a further development of the Siegel's rationalist thesis.

The main tenet of the thesis is that the ideal of education is to promote rationality and critical thinking. This rationality is broad, involving both epistemological and moral dimensions. Siegel (1996) defends the critical thinker as someone who possesses specific characteristics:

> "A critical thinker must have, then both a solid understanding of the principles of reason assessment, and significant ability to utilize that understanding in order to evaluate properly beliefs, actions, judgements, and the reason which are thought to support them. This dimension of critical thinking may be called the reason assessment component of critical thinking."

Following this, Siegel outlines two principles of reason assessment: general (applicable to many domains) and subject-specific (domain specific). Grasping these principles is considered to be an important part of critical thinking. Ultimately, Siegal supports that critical thinking is an educational ideal characterized by the following attributes: respect for students as persons, self-sufficiency and preparation for adulthood, initiation into the rational tradition, and democratic living. This educational ideal is, therefore, also a moral ideal. Thus, although critical thinking links directly with epistemology, it involves other dimensions as well when it is considered an educational ideal. It is also for this reason that Siegal believes it is important for philosophy and philosophy of education to engage in discourse.

This broad notion of rationality has not only an epistemological dimension, but also a moral dimension. For this reason, a large range of cognitive tools can be congruent with Constructivism's prescriptive component, concerned with learning activity that includes individuals' attitudes (moral).

Another important cognitive tool for Constructivist instruction is the imagaination. Imagination is a cognitive tool that represents Constructivist instruction as a higher order learning skill. Egan (1992) provides a very useful aid in shedding light on a powerful cognitive tool that contributes greatly to learning. This is important to the present discussion on Constructivism as a means of pointing to cognitive capacity often overlooked by instructional theories but essential to Constructivist instruction. Egan incorporates the cognitive tool of imagination into educational practices.

Egan (1992) argues for the necessity of imagination to be incorporated in education. He attempts to carry his concept of 'imagination' into discussions of conventional thinking, emphasizing the need for freedom of mental activity:

> "Imagination is what enables this transcendence, and is consequently necessary to education. It is important because transcending the conventional is necessary to constructing one's sense of any area of knowledge: accepting conventional representations is to fail to make knowledge one's own. It is to keep it inert rather than incorporate it in one's life."

Egan remarks on the tension that exists between conventions and imagination, marking it as a problem that has to be worked out. Also, Egan distinguishes the way in which humans learn from the ways computers operate in order to demonstrate that learning is not simply a question of recording symbols for later retrieval:

> "If we allow our technologies to determine how we think about our intellectual processes, then one effect, which has been pervasive and very damaging to education, is to think of learning as a process analogous to recording symbols in the mind for later retrieval."

Here, Egan is attempting to draw attention to the fact that the meaningfulness of learning requires a more flexible approach. He (1992) states, "The more flexibly we can think of things as possibly being so, the richer, and more unusual and effective can be the meaning we compose." Thus, memorization of knowledge only is simply not enough. However, the memory is considered to be important to the imagination, since it is that which is contained in one's memories that the imagination draws on with which to construct.

The above discussion on imagination builds on the discussion of cognitive elements, giving attention to a cognitive tool that has been neglected in the literature. In addition, the discussion on imagination makes an appeal to non-relativistic standards that extend beyond the practical instruction, transcending conventions. This gives a prescriptive element into educational practices that Constructivist instruction encourages.

Theoretically grounding non-cognitive tools in support of Constructivism

Recent innovative Constructivist research in the area of moral and cooperative learning has contributed to extending what is understood to represent Constructivism's theoretical grounding (DeVries, Reese-Learned, & Morgan, 1991; DeVries & Zan , 1996). This work has demonstrated that Epistemology is an element of the whole of Constructivist philosophy, which is dynamic, including not only descriptive but prescriptive elements. That is, it is not only about what is but also what could be. This is an important attribute of Constructivism that has been largely neglected.

The presence of broad treatments, such as Larochelle and Bednarz's (1998), suggests that the foundation of Constructivism cannot be exhausted by epistemological legitimization. There are also needs for cooperation and discourse, which have moral as well as epistemological conditions. Sensitivity to these non-cognitive tools is required for Constructivist instruction be initiated (Jonassen, 1994).

The moral dimension of Constructivism has received little attention in the contemporary Constructivist literature. However the need to consider moral dimensions of Constructivism is a pressing task (Piaget, 1965; 1981). Piaget (1965) argued against the Objectivist approach to education where instructors controlled all aspects of student learning. In drawing from his own work, he observed that such a control over learning resulted in mindless moral and intellectual conformity, leading to self-doubt, lack of curiosity, uncritical thinking, and problems in cooperative interactions. DeVries and Zan (1996) support a sociomoral theory of Constructivism aimed at encouraging cooperative sociomoral development. The authors believe that such considerations are necessary in order to prevent the loss of individual knowledge constructions and self-regulatory learning.

Attention is directed at promoting multiple perspective taking and moral reasoning among children to encourage greater interpersonal understandings. This perspective draws on previous research (DeVries, Reese-Learned, & Morgan, 1991), which found that children subjected to a Constructivist classroom setting invested greater effort to resolve interpersonal conflicts compared to children subjected to eclectic or didactic oriented kindergarten classroom settings. From this work, Devies & Zan (1996) support that rule and decision making should be directed, promoting feelings of necessity and fairness in rule making, a sense of commitment and ownership in decision making, and a sense of shared responsibility in how the group gets along. The result of this is believed by the authors to encourage mutual respect among learning. From this they conclude that a moral classroom contributes general conditions for intellectual development.

How can broadening Constructivism to include moral attributes aid in dealing with posited criticisms? First, on a theoretical level, it contributes to the understanding of Constructivist Instruction as not only descriptive but prescriptive as well. This builds on the discussion of cognitive tools by tying the prescriptive value of Constructivism to actual Constructivist research. On a practical level, it extends knowledge of Constructivism's

breadth with respect to learning content. It demonstrates that Constructivism is not only limited to epistemological constructions but also includes moral constructions. More importantly, this work brings to the surface an important aspect of Constructivism that has never been actually pursued but only speculated on by Bednar, Cunningham, Duffy, and Perry (1991):

> "Optimally, we would tie our prescriptions for learning to a specific theoretical position--the prescriptions would be a realization of a particular understanding of how people learn. Minimally, we must be aware of the epistemological underpinnings of our instructional design and we must be aware of the consequences of that epistemology on our goals for instruction, our design of instruction, and on the very process of design."

In addition, there is something extremely important to recognize when assuming a theoretical-practical connection that has not been addressed in the Constructivist literature. This is perhaps one of the most powerful Constructivist tools that has yet to be discovered. Given that there is an assumed theoretical-practical connection at the heart of all Constructivist inquiry (Bednar, 1991; Cunningham, 1991; Jonassen, 1991), any extension of Constructivist practices (e.g., moral and cooperative learning) also assumes a theoretical connection beyond other knowledge constructions acquired in experience. In this way, the theory of Constructivism is itself a meta-construction or meta-cognition. This is similar to Siegal's (1996) argument against Postmodernism.

One way to bind these cooperative and communicative practices to a theoretical grounding that supports both morality and rationality has been posed by Habermas (1990; 1993). Habermas advocates a communicative theory of meaning where claims of validity and truth are decided by resolving normative rightness, which can be determined through discursive argumentation. He summarizes the generalized moral imperative that corresponds to his theory of argumentative discourse. He states that, "All affected can accept the consequences and the side effects its general observance can be anticipated to have for the satisfaction of everyone's interests (and these consequences are preferred to those of known alternative possibilities for regulation)."

Habermas makes a concerted effort to bridge the gap between appeals for the communal shaping of values/practices with the autonomous role of the rational individual. For Habermas, moral practices are social matters to be decided by discourse interactions of individually deliberating subjects. Thus, both individual will and community practices are taken into consideration by Habermas' (1990) universal theory of argumentative discourse.

The importance this has for Constructivism is threefold: (1) it provides a means of making a theoretical-practical bridging generally assumed within the Constructivist domain, (2) it provides a connection between rationality and morality, and (3) it provides a means of connecting the individual and collective group.

Habermas' work could be used to support the Constructivist Theory of Learning and Instruction against Objectivist criticisms. Much of the criticisms surrounding Constructivism are directed at the inability to have any objective standards (Reigeluth, 1991). However, the theoretical grounding provided above with Habermas' Kantian project (1990) offers certain objective standards. Kant (1787) believed that the only genuine morality is one that would be objectively and universally binding. It would apply to all people and be the same for all. The basis of this morality that applied to all resided in rational nature. For Kant, it was rational nature that provided the binding force in which to ground morality. In his "Critique of Practical Reason" (1787), Kant defines "practical principles" and discusses their moral implications. Kant also states that, "Practical principles are propositions which contain a general determination of the will, having under it several practical rules. They are subjective, or practical laws, when the condition is recognized as objective, i.e., as valid for the will of every rational being."

This notion of objectivity is not the same as that to which Constructivism is opposed. The brand of objectivity that Constructivism opposes claims that knowledge representations correspond to the external world and that externally imposed standards based on this knowledge can be used to control teaching. This brand of objectivity controls the learner and prevents learning to be constructed. This is very different from the brand of objectivity discussed by Kant (1781), which does not claim objective knowledge of the external world at all.

Instead it assumes only objectivity that corresponds to the individuals' shared rational nature. It is not an externally imposed standard to control learning, but rather, represents an integral characteristic of each individual to be constructed in practical experience with others. What makes this limited brand of objectivity so attractive is that it allows for objective standards to be pursued as an essential part Constructivist Instruction. At the same time, it does not enforce any objective standards that would control learning. This is overcome by viewing objective standards as prescriptive standards to be progressed toward but never fully obtained. This form of objectivity as a rational standard is substantiated by the efforts throughout the paper to demonstrate the prescriptive components of Constructivist Instruction entailed by Constructivism's theoretical-practical assumption.

How does this contribute to the problem of learning assessments? How does an objective rational grounding address standards of evaluation required for effective instruction? The contribution made lies in how it is that standardized evaluative measures essential to instruction are treated. Under this view, problems of

evaluation are resolved by Constructivist instructions' prescriptive function. First, evaluations would not simply be administered but would be integrated as part of the learning process. This could be accomplished by making clear who is responsible for creating the evaluative standards and when. This way students can feel they are not merely subjected to some imposed standard, but rather are participating in the standard evaluation. This is done so that students can learn to understand the standard as a first step in being able to participate in the evaluation and selection of future standards. This can be taken to be a type of cognitive apprenticeship (Clancy, 1992; Cobb, 1996; Collins,1991).

Second, learners are participating in standard evaluations administered not with the understanding that the standard is objectively true but rather, is a logical possibility, objectively true for all learning participants and to be worked towards in a cooperative manner (Habermas, 1995; Kagan, 1990). This captures the essence of what Constructivism should encourage when attempting to provide instruction in an educational setting.

Conclusion

The previous discussion yields positive support for the possibility of supporting a Constructivist Theory of Learning and Instruction without adopting a Postmodernist stance. The following conclusions are drawn: (1) a close theoretical-practical connection assumed to be a defining element of Constructivist Theory and can be given support independent of a Postmodernist framework by appealing to a broader notion of rationality that is objectively grounded and co-extensive with the prescriptive idealization of education, and (2) a theoretical exploration of practical cognitive and non-cognitive tools reveals a connection between these tools with prescriptive elements valuable to Constuctivism and evolving education.

The issue of objective standards within Constructivism is found not to be a problem as many critics purport. While Constructivist Instruction does not base itself on the thesis of objective realism, incorporating objective standards within Constructivist instruction without opposing its fundamental tenets is a challenge. Concentrating on the necessity of rationality and the prescriptive component of Constructivist Instruction have revealed promising objective standards in which to imbed Constructivism. This adds an important element to the existing Constructivist paradigm.

Supporting the necessity of rationality and the prescriptive component of education has revealed promising objective standards in which to imbed Constructivist Instruction. Future work should be concerned with determining the extent to which such objective standards are effective for Constructivist instruction.

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An Instructional Design Model for Online Problem Based Learning (PBL) Environments: The Learning to Teach With Technology Studio

Larissa Malopinsky
Jamie Kirkley
Richard Stein
Indiana University

Tom Duffy
Unext.com

Abstract

This paper provides a discussion of the theoretical and methodological implications of designing a problem-based professional development system on the Web as well as describes an instructional design model using problem based learning (PBL) principles. The purpose of the paper is to help instructional designers understand the methods used by the LTTS team in developing and structuring PBL on the Web.

Background

Telecommunication networks are changing the nature of teaching and learning. In the past decade, Web-based learning has experienced rapid growth in various educational arenas. From corporate training to K-12 and higher education, many educational providers are now providing online courses and learning modules so learners can gain access to education anytime and anywhere there is an Internet connection.

Currently, more than 50,000 university courses are taught online, and 1,000 universities developing and offering these online courses (Carnavale, 2000; National Center for Education Statistics, 1999). Nearly all of Fortune 100 companies already offer some form of online computer-based training (Herther, 1997), and this will continue to increase as the demand for stand up training decreases rapidly (ASTD, 2000).

A need for periodic professional development has contributed to the demand for more flexible access to higher education. Organizations and institutions are increasingly offering online professional development opportunities to educators (Mather, 2000, Schrum, 1999). In current times, continual reskilling is a fact of life (Bonk and Wisher, 2000), especially for teachers who must keep up with new teaching strategies, the latest professional standards, and constantly changing technologies. Coincidentally, new technologies promise to facilitate access to learning at times and places chosen by the learner (Albion and Gibson,1998). These web-based environments have the potential to transform teacher professional development through the use of new models of teaching and learning. Online environments also have the potential to facilitate a sustained culture of sharing, collaboration, mentoring, and support for K-12 teachers.

With the rapid rate of expansion of online education, there has also been a call for a renewed focus on understanding and improving online teaching and learning. As a result, institutions are designing and implementing new models of distance learning environments (Institute for Higher Education,1999). The goal of these learning environments is to promote learner engagement using inquiry and problem solving. One such methodology being implemented online is problem-based learning. Problem-based learning (PBL) is often promoted in response to the current need to offer authentic and effective professional education. Jonassen (1991) argues that "the most effective learning contexts are those which are problem or case based and activity oriented, that immerse the learner in the situation requiring him or her to acquire skills or knowledge in order to solve the problem or manipulate the solution" (p. 36).

Problem-based learning is a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems (Finkle and Torp, 1995). Traditionally, PBL is used in face-to-face environments, with a facilitator guiding collaborative teams of students in solving a problem. PBL was initially developed at McMasters University in the late 1960s. It is used in a wide variety of educational environments including medical education (Barrows, 1985), business administration (Stinson and Milter,1996), schools of education (Bridges and Hallinger,1992), undergraduate education (White,1996), and K-12 schools (Barrows and Myers,1993). Problem based learning environments are often reported to increase student

motivation, to help develop critical thinking skills, to increase use of outside learning resources, and to increase understanding of content knowledge in context of its use (Albanese and Mitchell,1993, Torp and Sage, 1997).

As traditional PBL has naturally expanded to many curricular areas, it has also expanded to the online educational arena (Stinson and Milter, 1996; Oliver and Omari, 1999; Pankratz, 1998; Naidu and Oliver, 1996). Yet online learning environments are new, and principles for the design of instruction in this environment are just emerging [Duffy, Dueber, and Hawley, 1999; Bonk et al, in press]. This means that instructional designers are the first who face the challenge of incorporating PBL approaches into the Web structure.

Heath (1997) recognizes a trend in instructional design towards replacing traditional behaviorist approaches with constructivist orientations emphasizing the use of emerging technologies. Therefore, understanding how to design and support the online problem based learning process is critical to the effectiveness of such online learning systems. Since few instructional designers have experience in developing problem based instruction for a Web based learning environment, it is critical that we provide instructional models focusing on the design of online problem based learning systems.

In this paper, we provide an instructional design model for designing a problem-based professional development system on the Web, called the Learning to Teach with Technology Studio. This model will help instructional designers better understand the theory and methodology of online problem based learning and enable them to adapt it as needed for their own online learning environments. This model will also help support new models of professional development for K-12 teachers. Understanding how to design online professional development systems for in-service teachers is important given recent recommendations from the professional development literature. The design of these online learning environments presents unique opportunities for transforming current models of preK-12 professional development. "Rather than having information delivered to them, teachers need to examine their beliefs about subject matter, student learning and instruction in the light of innovation" (Marx, Blumenfeld, Krajcik, and Soloway, 1998, p. 33). These models build on continuous inquiry, integration of new ideas with colleagues, and reflective practice, which are critical elements of successful professional development (Shanker, 1990).

Theoretical Framework

Before we discuss the instructional model used in the design of the Learning to Teach with Technology Studio, it is important to address the theoretical framework that was used as the basis for its development. Constructivism served as the guiding theoretical framework for the development of this instructional model. Constructivist theories of learning posit that knowledge evolves through social negotiation and through the viability of individual understandings, that understanding come from our interactions with the environment, and that cognitive conflict or puzzlement is the stimulus for learning and determined the nature of what is learned (Duffy and Cunningham,1996; Savery and Duffy, 1996).

During the past several decades, there has been an important shift in the way we view knowledge as well as the process of learning. Knowledge was once viewed as a known set of discrete *facts* to be *acquired* during the learning process via a simple process of *inputting information* into a learner 's head. Within a Constructivist framework, the focus is on the role of the learner. Rather than simply acquiring existing knowledge, the learner constructs knowledge through a complex set of interactions with the environment, culture, negotiations with other people, and tools (technological and otherwise) used in the process of learning. As learners engage in the social construction of knowledge, meaning, practice, and context are inextricably woven together (Lave and Wenger, 1991; Naidu and Oliver, 1996). Savery and Duffy (1996) link the theoretical principles of constructivism with the methodology of problem based learning as follows:

- Learning should be relevant
- Instructional goals should be consistent with the learner's goals.
- Cognitive demands and tasks in the learning environment should be consistent with cognitive demands and tasks for the environment for which the learner is being prepared.
- Teachers' role is to challenge the students' thinking.
- Students' ideas should be tested against alternate views through social negotiation and collaborative learning groups.
- Encourage reflection on the learning process (p.137).

By using Constructivist theories of learning as the basis for the development of this instructional model, we considered the role of the learner, the knowledge construction process, and the learning environment. By using the principles of Constructivism to guide the development of an online problem based learning instructional model, we

can design educational environments that further develop learners' critical thinking and problem solving abilities, content knowledge, skills, strategies, and learning processes.

The Learning to Teach with Technology Studio

In order to understand this instructional model, it is first necessary to understand the context in which this instructional model was created. In 1999, Indiana University's Center for Research on Learning and Technology received a grant from the Department of Education to develop the Learning to Teach with Technology Studio (LTTS). The LTTS is a web-based professional development system to help K-12 teachers learn to use technology to support student inquiry and problem solving. (See **http://ltts.org** for more information). The LTTS is being developed to address needs of K-12 inservice teachers who lack skills and confidence in integrating technology into their teaching. While the technology infrastructure grows — 51% of classrooms are wired for Internet access, and there is one computer for every 5-7 students (National Center for Education Statistics, 1999; President's Panel, 1997) — the ability to use it lags. The Milken Exchange (Solmon,1998) found that teachers do not model the use of IT skills in their teaching., Eighty percent of teachers report that they do not feel well prepared to integrate technology with their teaching (National Center for Education Statistics, 1999). Little seems to have changed since the 1995 OTA report concluded, "Overall, teacher education programs in the U.S. do not prepare graduates to use technology as a teaching tool" (Office of Technology Assessment, 1995, p. 184).

The challenges of this were to design an online learning environment based on the following criteria:

- To meet the needs of K-12 teachers in helping them learn about technology integration issues
- To create a learning anytime and anywhere which is open entry and open exit
- To design a learning environment that could be used by teachers' current technology levels as well as technological resources, which are all extremely varied
- To design a learning environment that emphasizes the individual but promotes community
- To design a learning environment that integrates the latest research and pedagogical innovations into daily classroom practice
- To provide high quality resources for learning
- To enable teachers to enhance their knowledge for using technology in their subject area while addressing professional standards

The current emphasis on technology is to ensure that it is used effectively to create new opportunities for learning and to promote student achievement. Educational technology requires the assistance of educators who integrate technology into the curriculum, align it with student learning goals, and use it for engaged learning projects" (NCREL, 2000) "Teacher quality is the factor that matters most for student learning," note Darling-Hammond and Berry (1998). Therefore, professional development for teachers becomes the key issue in using technology to improve the quality of learning in the classroom.

To address this need, the LTTS is being developed to provide learning modules that help teachers learn to integrate technology to support student inquiry and problem solving. These learning modules are self-contained, problem-based learning packages where a learner is presented with a problem scenarios based on significant technology integration issues that they face today, such as learning how to choose Internet-based projects, design WebQuests, and evaluate information found on the Internet. The goal for solving the problem is related to the teachers' own classroom context. So the teacher may develop an Internet-based teaching unit for her own class, choose an appropriate technology for her own students' collaboration, or learn how to teach Internet search models to her students.

Considering the meaning of professional development in the technological age, Grant states:

> "Professional development goes beyond the term 'training' with its implications of learning skills, and encompasses a definition that includes formal and informal means of helping teachers not only learn new skills but also develop new insights into pedagogy and their own practice, and explore new or advanced understandings of content and resources. [This] definition of professional development includes support for teachers as they encounter the challenges that come with putting into practice their evolving understandings about the use of technology to support inquiry-based learning" (NCREL, 2000).

Additionally, the U.S. Department of Education (1995) set forth several related principles that professional development should meet, including:

- It should reflect the best available research and practice in teaching, learning, and leadership.

- It should enable teachers to develop further expertise in subject content, teaching strategies, uses of technologies, and other essential elements in teaching to high standards.
- It should promote continuous inquiry and improvement embedded in the daily life of schools.

In developing the LTTS, these professional development principles were considered as part of the design. Problem based learning was chosen as the methodology because of the strengths and advantages it offers for supporting teachers' professional development and learning. First, PBL builds on the use of teachers' research and practice in teaching and learning. Because the learner must address real classroom problems and issues using the latest research and other resources, they are connecting research to classroom teaching and practice.

Third, PBL provides a model of inquiry and investigation for teachers to learn not only for themselves but to apply to their own classroom practice. The PBL process requires that teachers address questions, make hypotheses, research and investigate issues, and develop a project that addresses the problem or issue.

In conclusion, the context for which this online PBL instructional design model was developed is critical to understanding the model itself. Other designers will perhaps need to adapt this model for their own particular contexts, but this will provide a starting place for their efforts.

Adapting PBL for a Web-Based Learning Anytime, Anywhere Environment

Since the LTTS is a web-based learning anytime anywhere environment, using problem based learning as a design framework required that we adapt PBL to work with this environment. This resulted in the development of a new instructional model. In making this adaptation, we considered the characteristics of web-based learning environment, the needs and characteristics of our learners, and their goal for using the LTTS.

First, several distance learning principles guided the development of this model. Since our learners are from diverse backgrounds, we cannot make common assumptions about them with regard to prior knowledge of technology integration and usage, knowledge of terms or current issues, or knowledge of inquiry based learning. So we designed a very structured PBL experience with built in scaffolding activities that help support the learner in solving the problem.

Second, finding high quality resources on the Web is a challenge for novices who do not know the research or current issues. Therefore, we provide some high quality resources to assist the learner in solving the problem. These resources are provided within activities as well as separately in a resources section. Also, learners are encouraged to find other high quality resources to use in solving the problem and contribute those to the system for others to use.

Third, the navigation of the Web can inhibit learning is it is too complex or difficult to use. If learners have to focus efforts on finding information or figuring out where to go next rather than learning, they can become quite frustrated. So we designed a navigational system that illuminates our PBL instructional model and process. In fact, in a usability test conducted with six teachers (Kirkley et. al., 2000), we found that teachers understood the PBL flowchart style navigation and liked its consistency.

With regard to adapting PBL for a learning anytime anywhere environment, several adaptations were made. First, a traditional PBL model typically includes collaborative group work and tutor and a facilitator who models higher order thinking and challenges the thinking of learners. In designing PBL for a Web-based format where learners are separated from each other and from the facilitator by time and space, there is a challenge for the instructional designers who want to apply PBL principles in developing online learning environment. This realization forced our design team to consider the ways in which learners and facilitators would want and need to communicate with each other.

In order to implement PBL on the Web, we explored the role that collaboration plays in the overall experience of PBL but within the framework of a learning anytime, anywhere environment. Within a face-to-face PBL framework, learners have active, group-based roles at some stage of the process for the purpose of determining solutions and synthesizing knowledge. In outlining PBL, Boud (1985) and Bridges and Hallinger (1992) emphasize the importance of a group role when learning stems from collaborative analysis of the problem and is largely learner-directed. Yet within a learning anytime, anywhere environment, it is difficult to set up a collaborative group experience. With open entry/open exit structure, learners are completing modules at their own pace. While learners can participate and discuss issues with other learners, collaboration would be extremely difficult.

The role of the facilitator in LTTS is flexible since the type of facilitator and location of the facilitator will depend on the learner's goals for completing a module. For example, if a learner is completing a module for graduate credit, he may work with a facilitator at that university in which credit is being obtained. If a learner is completing a module to receive continuing education credits, he may work with his state monitor who acts as facilitator. If a learner is completing a module to improve technology integration skills, he may work with his

district staff developer. With this design, facilitators will have difference backgrounds, goals, and expectations, so instruction and assessment must be well designed.

Studies of the cognitive and metacognitive processes of students during the initial problem analysis phase of PBL support the view that the role of group interactions in PBL is to facilitate activation and elaboration of students' existing knowledge and so encourage conceptual change through cognitive dissonance (De Grave, Boshuizen, and Schmidt, 1996). If this is the function of group interaction in PBL, then, provided that an alternative mechanism with an equivalent effect is introduced, it should be possible to design effective PBL for individual use.

Exploring the value of PBL experiences for individual rather than collaborative use may be justified by the fact that professional practice is situated in a variety of contexts including individual study as well as collaborative and competitive teams. Successful professional practice frequently depends upon individual's capacity to solve problems. Logically, educational experiences which develop that capacity should be valued. Individual PBL experiences may help to address the increasing interest in distance and flexible access to professional education and the increasingly successful technology integration (Albion and Gibson, 1998).

Thus, not diminishing the value of collaboration and facilitation, we have developed instructional design model for individual web-based PBL, using appropriate alternatives which will assist learners through the problem solving process. Gibson and Gibson (1995) describe an alternative approach in which a learner is engaged with a problem individually and prepares a written analysis of the problem in preparation for group interaction. Within LTTS, this is done through module navigation and visual format, the use of scaffolding approaches, such as breaking the larger problem into sub-problems, the inclusion of the heuristic aids, the integration of metacognitive self-assessment tools as well as various mechanisms for supporting cooperative work on the problem at a distance. All these elements are intended to assist the learner in the individual PBL web-environment.

Web-Based PBL Instructional Model

According to our PBL model, which is very similar to traditional PBL models (Barrows and Myers, 1993), the LTTS learner goes through the series of phases in order to finally generate a problem solution. The problem scenario begins with identification of key concepts from the content domain and a typical context in which the concepts might be used. This ***Presentation Phase*** is intended to situate the learner in the problem context and to begin the process of activating relevant prior knowledge. Additionally, it is in this phase that learners have the option of beginning to customize their interpretation of the problem to make the context as specific as possible.

The ***Exploration Phase*** provides opportunity for recall and reconfiguration of prior knowledge relevant to the specific problem and exploration of additional, content specific knowledge and 'experience' gained during problem solution. Learners have access to a collection of resources relevant to the concepts encapsulated in the problem. We want them to identify possible solutions and resources needed for understanding the problem.

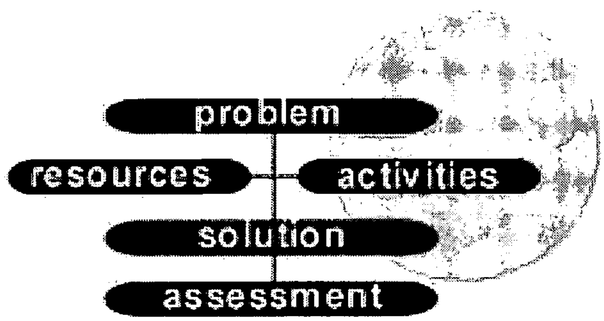
The ***Integration Phase*** emphasizes relevant knowledge transfer, analysis, integration, synthesis and evaluation of selected, content specific knowledge and problem based 'experience'. The problem in each module is divided into a series of tasks/sub-problems to facilitate scaffolding by considering the types of artifacts, typically documents of various kinds, which might be produced by the learner in association with a stepwise solution to the problem situation. Because PBL is intended to increase the capacity of learners to solve real problems and because identifying critical elements may be counter-productive, the learners are required judgment in selection from what is provided and initiative in employing material from alternative sources in order to be able to solve the problem. But we need to note that resource collection and analysis to some extent is embedded into each phase of the process.

The ***Solution Phase*** encourages learners to further integrate knowledge, 'experience' and artefacts gathered through the problem solving process into their cognitive structures as though products of real experience.

During the ***Reflection Phase*** learners are encouraged to conduct self-assessment of their artifacts assessing the content and organization of the learning modules according to the particular domain of technology integration.

Each learning module in the LTTS system is a self-contained, problem-based learning package, which presents a scenario, which includes a problem, resources, activities, solution, and assessment. The problem may ask the student to develop, design, or critique something such as an effective use of technology to meet a need, the resolution of an ethical dilemma, or the critique of a web interface. Students are asked to produce a product such as a report, or the development of an instructional plan or materials to address the problem. In all cases, the problem is flexible and enables learners to approach solving it from their own perspective and context. For example, rather than being given artificial scenarios, the learner solves the problem using the context of his or her own classroom. Each problem is authentic because it is related to a significant issue in the classroom today.

The module navigation scheme visually represents the problem solving process, and helps the learner organize working process.



The *Problem* section is intended to provide a situation description, a concrete and authentic context out of which arises a problem to be resolved or a project to be completed. It contains background information that helps establish the importance and broad relevance of the problem to the teaching and learning environment. The problem presentation contains enough information to make the problem intriguing, yet general enough to allow the learner freedom in determining the shape of the solution or product. The problem presentation includes a specific description of the role learner will adopt while working on the module. The problem needs to be important and containing motivating factors such as mystery, puzzlement, novelty, originality, and high relevance.

The purpose of the *Resources* section is to provide the learner with core materials that are of high quality and relevant to the problem. Our goal is for the learner to understand the resources as reflected in the learner's ability to apply them to the problem, which contrasts to the traditional learning environment that measures understanding by performance on a test rather than in the ability to apply concepts and principles. Module resources are primarily links to authentic materials (online research publications, projects web sites, online interviews, etc.) serving as a support to problem solving process. Resources may also include references to off-line materials such as books, magazines and videos. While we provide learners with a list of resources, we do not discourage them to use other materials they see as relevant and useful in the process of solving the problem.

Activities in problem-based LTTS module serve as scaffolded instruction that prepare the learner to develop problem-solving strategies. Due to the challenges of online environment, and considering the lack of instructor or facilitator, we divide problem into sub-problems or tasks that scaffold, model and coach the learner in his/her thinking and learning. Each activity is built around the issue relevant to the overall problem and includes links to resources presenting this issue. The learner is expected to complete a written analysis of some aspects of the problem for the purposes of synthesizing knowledge and determining solutions. All submitted works are stored in the system database and the learner has an access to them at the later stages while preparing the final product. The learner has an opportunity to modify and resubmit his/her work and retrieve his/her works in the *Solution* section in order to support the final product.

When the learner has completed the tasks specified in module *Activities* he/she is expected to prepare a final product, *Solution* for the problem. The solution can be prepared in the format of a paper, project, job-aid or instructional materials addressing the problem. The final product must address the major decisions that were made and should be based on or cite research, theory, or practice that grounds the decision making in the literature. In *Solution* section the learner has an opportunity to review his/her earlier work from Activities and create a final product.

The purpose of the *Assessment* section is to encourage and help structure the learner's reflection on his/her performance through a series of reflection questions. We recognize the importance of reflective questions for understanding the learners' thinking and assisting them move through the experience. In our design, we adopted the portion of Naidu and Oliver's PBL model (1996) that deals with reflection at multiple points in the process. We included two types of reflective questions that proved to be most important: check-up questions, and stepping back questions (Hmelo and Ferrari, 1997). Check-up questions are the ones that help students think about they goals as they work. In LTTS module these questions take the form of self-checks integrated into each activity. The second set of questions, stepping back, take the form of final reflection questions that ask the learners to reflect on the whole process of solving the problem. Reflection is considered a critical tool for synthesis as well as for facilitating students' forward motion in the problem environment (Orrill, 2000).

Reflection on the Instructional Model

Admittedly, the structure we used for web-based problem solving process is much more rigid than traditional face-to-face PBL environment. However, Abrami and Bures (1996) recognize that setting the agenda for students learning at a distance may be problematic since learners structure to help in planning and managing projects. This is

why we structured the problem solving process by dividing the problem into a set of sub problems, or activities. Wegner, Holloway, and Grader (1997) also confirm the need for structured support in their online PBL experience. Their issues focus on the development of particular content knowledge. They use some imposed structures such as process-oriented questions and lists of key terms and concepts in order to help their students move through the PBL experience and reach the desired outcomes. While this may have prevented the students from arriving at the "knowledge abstraction' phase of PBL (Barrows, 1985), it likely helps them stay on track to finishing the problem.

Compromising certain aspects of the problem-solving experience, we are also scaffolding learners to help them work in web-based environment. However, while providing more rigid structuring strategies we do not eliminate the most of the critical elements of PBL. A community of peers and a facilitator provide ongoing support to learners working on the problems individually. Corrent-Agostinho, Hedberg, and Lefoe (1998) emphasize that the most successful learning experiences are those in which the environment both structured and well facilitated.

The role of the facilitator is not to inform but to model higher order thinking and to challenge the thinking of learners (Boud, 1985; Savery and Duffy, 1995). Studies of student interaction with peers in the PBL environment (De Grave, Boshuizen, and Schmidt, 1996) suggest that exposure to different ideas in the group leads to conceptual change. The group interactions serve to encourage activation and elaboration of existing knowledge and integration of alternative views. Providing the style of support which the learner typically receives from the facilitator and peers in the face-to-face PBL environment presents an obvious challenge to the web-based PBL design. In our design, we are considering several options to satisfy the learners' need for group interaction and facilitation of their activities. The LTTS design team is developing various mechanisms (discussion forums, chat rooms) to support the process of building a community of learners interested in the similar problematic issues, discussing authentic experience, creating mentor-type relationships and teams to work together on the same problem. Another strategy, which would compliment the group interactions, is incorporating a feedback mechanism through which after completing a task the student will obtain access to a collection of responses containing varying interpretations of a problem. It is anticipated that exposure to a collection of responses in this way will have effects similar to interactions among a group of learners with differing vision of a problem and its solution. We hope to develop such an environment where the learner utilizing the individualized PBL model in a web-based learning environment will be able to receive both human and technology support.

At each stage of the design process, we used rapid prototyping techniques to ensure that the overall scenario was plausible and the problem process flowed naturally according to learners' perspective (Tripp and Bichelmeyer, 1990). This was done through having inservice teachers examine the modules in depth and make suggestions. Also, usability testing was conducted with six teachers, who are the real audience for LTTS.

Conclusion

This is a new instructional model for Web-based PBL. Obviously, it is not the same as traditional face-to-face PBL, and it is not our purpose to duplicate the traditional face to face PBL, which has the strengths of group collaboration. Our goal is to take the best of PBL learning and develop a new instructional model that would work within a Web-based learning anytime, anywhere environment. In doing this, we have to consider both the strengths and constraints of web-based instruction, learner characteristics, and the purpose of the LTTS, which is professional development. We need to understand the strengths and limitations of the online environment and learn how to operate within these. We also have to understand what aspects of PBL will work in these environments and will enhance professional development as well as how PBL needs to be adapted to fit the learning environment in which it occurs.

This instructional model is just one of many possible implementations of PBL on the Web. As communication technologies advance, there will be future instructional design models of PBL that are even more innovative. McLoughlin and Oliver (1999) argue that we need to develop online tools to support parallel problem solving, simulating course material, information exchange, database creation, and case-based projects. As new tools are created, instructional designers will need to develop enhanced instructional models that facilitate and support the inquiry and problem solving processes within the context of the areas being studied.

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Distance Education: Looking Beyond the No significant Difference

Nancy J. Maushak
Hui-Hui Chen
Laura Martin
Benny C. Shaw, Jr.
David Unfred
Texas Tech University

Abstract

A review of research in distance education indicates thatresults are consistent in that there is no significant difference in achievement contributable to the delivery system. And it is this 'no significant difference' that seems to be quoted most frequently. Thisperspective represents a very narrow vision of what research is actually occuring in the field of distance education. This paper attempts to look beyond or behind this no significant difference in achievement by examining research related to threeother factors: learner interatction and control, two different approaches to multiple learning styles and ,utilizing intelligent agents to facilitate interaction and collaboration. The approach has bee taken to not simply reviw what has been studied but to examine areas for future study that will make significant contributions to the field.

Introduction

Research in distance education has tended to follow the same trends as research with other new technologies. The first factor that is explored is related to learner outcomes. The temptation is there to try to prove that the use of new delivery systems result in higher student achievement. The multitude of media comparison studies conducted in the area of distance education have shown repeatedly that distance education is at least as effective as traditional education in regards to learner outcomes (Hanson, et. al, 1996, Russell, 1999, Saba, 2000). In fact, several studies have produced results that indicated distance education students had a higher achievement than those in traditional settings. However, a review of the literature supports a perspective of research in distance education that is examining this phenomenon from multiple approachers. This paper presents an examination of the research in distance education examining factors beyond achievement including emerging technologies, learning styles and interaction.

The first section will look at using CAI to support K-12 distance education. While CAI appears to be decreasing, it offers intriguing possibilities when explored for its distance education potential particularly in the K-12 setting. Learning styles appear frequently in the distance education literature. However, the utilization of multiple models and instruments makes interpreting and generalizing the results difficult. The second section explores a classification system for learning styles that would prove useful to help interpret the research related to learning styles in distance education. The third section explores learning styles in one specific setting. The use of Web-based instruction continues to increase but little has been studied in regards to learning styles and designing web-based instruction that supports multiple learning styles. The fourth and final section, examines the emerging technology of intelligent agents and what impact this might have on changing the paradigm of distance education.

Using CAI to Facilitate Distance Education in K-12

Since 1985, distance education has been growing as a means of teaching and learning. Distance education enables bringing knowledge to students regardless of the limitation of time and geographical location. It has been typically defined both as a synchronous mode and as an asynchronous mode. Contemporaneously, Computer-Assisted Instruction (CAI) has been evolved since 1960s. CAI is an effective intervention for improving students' achievement in different subject areas (Christmann, Badgett, & Lucking, 1997). Researchers have dedicated many efforts and money to study and improve the instructional design of CAI. However, with the rapid development of distance education, the use of CAI seems to be decreasing in popularity. It is no longer the spotlight compared to the foci on other delivery methods within distance education. Nevertheless, CAI has another chance to gain the attention of instructors and instructional designers again with the increasing use of distance education within the context of K-12.

Instructional Forms

Lauzon & Moore (1989) thought that a successful application is dependent upon understanding how the technologies can be used to enhance distance learning. Hence, it is necessary to review instructional forms prior to adopting a specific instructional design for distance education. Kowitz and Smith cited in Lauzon &Moore (1989) mentioned the three forms of instruction represent positions on two dimensions: the density of content to be learned and the styles of human interaction. Different instructional forms require different styles of learner/instructor interaction.

The first form represents learning the basics. It is characterized by instructor control of the development, design, and evaluation. The second form assumes students an active role in their education. The instructor acts as an expert and becomes more consultative with students. It is characterized by instructor control as well as learner control of field study. The third instructional form is characterized by experts seeking to improve and master their existing knowledge and performance. It is more toward learner control.

Factors Influencing Learning, Interactions, and Control in Distance Education

Vrasidas and Mclsaac (1999) concluded the structure of the online transaction, class size, feedback provided to students, and students' prior experiences were the major factors to influence interactions. Baynton (1992) indicated that the factors of "control" in distance education are competence, independence, support, time flexibility, value orientation, and access to resources.

By comparing aspects of studies, we can make an assumption that we are comparing students' expectations (Vrasidas & Mclsaac, 199; Baynton, 1992) and teaching behaviors (Mckenzine et al., 1998). Students' expectations are more in terms of self preferences, while teaching behaviors are more in terms of management and instructional concerns. Nevertheless, requiring and providing support and feedback are congruent.

Distance Education in K-12

Currently, most of the attention given distance learning programs in K-12 schools is focused on synchronous modes of instruction (Barker & Dickson, 1996). Schools are using distance education technologies to help them offer both elective and required courses for which a certified teacher is not available or in situations where low student enrollments do not qualify a full-time teacher being hired. Barker and Dickson (1996) indicated that the most common technologies used in distance education programs in K-12 have been satellite-delivered instruction, cable television, and computer audiographics. Even so, Barker and Dickson also indicated that the use of the Internet and the Web to assist distance education has been emerging.

Characteristics of CAI

It is essential that CAI applications be examined in order to seek consistency with instructional forms as well as interaction styles and controls mentioned above. Thesaurus of ERIC descriptors cited in Fourie (1999) defines that CAI stands for an interactive instructional technique in which a computer is used to present instructional material. CAI can monitor learning as well as present corresponding instructional material to what individual learner needs. Lockard, Abrams, and Many (1997) described the nature of CAI as the following:

> Computer-assisted instruction (CAI) is the most common term for the interaction of a learner with a computer in a direct instructional role. CAI software provides instruction in some particular content in any of a variety of formats, with or even without any involvement of a human teacher. (p. 190)

The major characteristics of CAI are interaction, flexibility, and meeting student needs (Lockard, Abrams, & Many, 1997). CAI engages learners interacting directly and continually with computers. Learners take active roles instead of passive roles in their learning processes. It provides feedback to learners as well. Its flexibility allows teachers involving in teaching both higher-order problem-solving and simple cognitive learning. Furthermore, it can response to different needs due to different levels of competencies that learners hold. The advantages and disadvantages of CAI in terms of distance education are discussed in the following.

Advantages. The advantages of CAI are (Fourie, 1999; Lockard, Abrams, & Many, 1997; Luzon & Moore, 1989; Daniel, 1999):

1. Interaction: CAI engages learners interacting directly and continually with computers.
2. Immediate feedback: CAI is capable of providing immediate feedback to learners.
3. Self-pacing: Learners can learn at their own paces with CAI.
4. Visualized effects and sound: Integrated effects can impress learners to keep their retention and extend the duration of their learning.
5. Branching for different interests or difficulties: Learners can go through the order depending on their own learning styles and entry levels.

6. Providing sufficient drill, practice, simulations, and games: CAI provides plenty of opportunities to learners to do drill, practice skills, simulate problems, and have fun while learning.
7. Independent tutorial: Learners can go through the tutorial when they need.
8. Allowing a large number of learners: CAI applications can be duplicated and distributed easily.
9. Time flexibility: Learners can use CAI at their own convenience.

Disadvantages. The disadvantages of CAI includes ((Fourie, 1999; Lockard, Abrams, & Many, 1997; Luzon & Moore, 1989; Joseph, 1999):

1. Cost to develop: It is expensive to develop a new CAI application and takes much time and many efforts of people involved.
2. Computer platforms: If CAI only used for distance education by distributed learning, different computer platforms that learners have should be considered and can be a problem.
3. No standards to apply applications: There is no standard for what CAI application to apply for courses.
4. Requiring computer skills: Certain computer skills are needed while working within an CAI application.
5. Lack of synchronic oral communication.
6. Eyestrain: It is easy to get eyestrain after a long period of watching the computer screens.

However, Olcott (1997) argued that distance education does not necessarily save money in the short term if we view distance education from a value-added perspective.

Discussion and Conclusion

Olcott (1997) stated the shift to competency-based assessment models that certify learning through mastery of specified skill competencies rather than learning based on credit hours and seat time has impacted K-12 school restructuring initiatives. The shift may use CAI applications to achieve its goals since CAI applications can provide students with what individual needs and enhance learning. CAI can work for K-12 students in the diverse subject areas and further in the distance education context.

CAI is well known for its ability to address the independence of learners. This aspect relates well to how distance education works for most participants. Through distance education, K-12 schools can obtain collaborative and cooperative teaching and learning. CAI has the potential to enrich and facilitate distance education for K-12 schools. With the help of CAI, the use of distance education in K-12 could be extended to every single possible geographical and content area.

CAI is congruent with how distance education works. Traditional distance education programs of the past 10 years operate mostly in the synchronous mode; however, increasingly, programs are being offered in the asynchronous mode especially because of the rapid development of the Internet and the World Wide Web (Baker & Dickson, 1996). Garrison's opinion (1986) cited in Lauzon and Moore's observation (1989) indicated that the new generation of delivery system for distance education should be capable of both asynchronous group and individualized instruction and integrate the communications network with computer-based instruction. In other words, CAI combining with the Internet and the World Wide Web is the ideal application for distance education. It is evidenced that Web browsers are powerful programs which can integrate various types of media. Web browsers provide an inexpensive and widely available application that can combine text, graphics, audio, video, data, and programming within the same software program (Daneil, 1999). Consequently, CAI on the Web does not need to address the problem caused by the different platforms of computers

It is easy to update or upgrade CAI applications via the Internet so as to save cost and time from publishing and distribution. While learning with CAI, learners will have easy access and jump to different resources due to the connections with the Internet and the context of the World Wide Web. Learners also can acquire immediate use of e-mail, chat-room, and even Internet phone to have online communications with others. Developing CAI for the Web also facilitate collaboration by geographically dispersed institutions (Daneil, 1999). This will increase collaboration and cooperation between schools.

In sum, CAI applications for distance education for K-12 students should integrate with the Internet and the Web. The Internet provides synchronous settings as well as asynchronous. The implements and potentials of CAI on the Web in distance education for K-12 need to be studied by researchers, instructors, and designers much farther in the future.

The Influence of Learning Styles in Distance Education

Research studies in distance education have measured learning styles using different instruments and have classified these styles according to various schema. Most of these studies used subjects that were either not representative of the population or were samplings of convenience. These conditions complicate the comparisons of the resulting data. In order to compare learning styles across these research studies, the learning style instruments and classifications need to be related to general models. Claxton & Murrell (1987) have classified learning style instruments into three broad learning style models: 1) instructional preference, 2) social interaction, and 3) information processing.

Instructional preference models address motivation and persistence of the learner. Social interaction models are learning style models that address the learner's need for an interchange of ideas or knowledge with one or more people concerning the learning material. Information processing model address the influence of the structure of the instruction, an individual's self-concept as a learner, distinct personal goals, and expectations of success or failure on the amount of information learned. Learning styles are the combination of the developmental, cognitive, and affective factors that influence the way in which we process and perceive information.

Instructional Preference Models

Instructional preference models are learning style models that are associated with environmental and emotional preferences. Emotional preferences that address motivation, persistence, and structure have been extensively studied in distance education. Research has shown that knowledge acquired through activities that motivate the individual is learned more deeply than rote memorization (Cognition and Technology Group at Vanderbilt, 1993). Persistence, which is a function of motivation, is the extent to which an individual continues to do an activity.

In distance education, many research studies have investigated the persistence of learners either within a course or within a program. These studies have examined previous educational level, age, gender (Coggins, 1988; Powell, Conway, & Ross, 1994; and Richards & Ridley, 1997), employment, illness, family problems (Coggins, 1988; Gibson, 1996; and Powell et.al, 1994), support programs, tutors, and quality of instructional material (Powell et. al., 1994). Many different schemes have been used to provide an explanation or prediction of attrition, but the single point of agreement is that attrition is multivariate in nature (Gibson & Graff, 1992). When examining how learning styles affect persistence, we must look at emotional elements that relate to motivation. Motivation, whether intrinsic or extrinsic, helps to drive the student to learn a particular piece of information. With intrinsic motivation, a learner is driven internally by interest and curiosity and learning that piece of information is important to the learner himself. A learner that is extrinsically motivated is driven to learn a particular piece of information by a requirement imposed by some outside force. The importance of that requirement to the learner will determine that amount of drive to learn the information.

Another factor that is common in a number of distance education persistence studies pertains to the learner's perception of his ability to succeed in the educational setting (Gibson, 1996; and Powell et. al., 1994). A learner's academic self-concept is important as a predisposing characteristic in the learner's ability to complete a distance education program (Coggins, 1988). The confidence a learner has in his ability to succeed in a course could affect the learner's motivation

Coggins also stated that major motivational factors influencing a learner's persistence in a distance education course are goal-clarity and course relevance. These motivational factors can be intrinsic or extrinsic factors and are significant influences on distance education persistence. The students who intend to earn a degree and/or who were taking a distance course that was relevant to their degree program were more likely to complete the distance education course or program (Coggins, 1988; and Powell et. al., 1994).

Social Interaction Models

Social interaction has been shown to be a significant factor in determining distance education success. Individuals who prefer a collaborative learning style, where interaction with other learners is important, are less likely to succeed in a distance education environment (Dial & Cartnal, 1999).

A recent study examined the implementation of groupware into an asynchronous learning environment and found that groupware facilitated the group learning process (Becker & Dwyer, 1998). This study also investigated visual/verbal learning preferences of the students. A comparison of visual/verbal learning styles to independent/dependent learning styles has not, to my knowledge, been conducted with respect to distance education. However, accepting the fact that dependent learners learn best when interacting with other students or teachers, a preference for verbal learning would include dependent learners. Interestingly, Becker and Dwyer found that students who were categorized as more visual learners perceived an added benefit from utilizing groupware and considered the groupware to be valuable in the group learning process.

Information Processing Models

The amount of information processed and the amount of information learned are influenced by an individual's self-concept as a learner, distinct personal goals, expectations of success or failure, and preference, or lack of preference, for structured learning activities (Gibson, 1996; Wagner and McCombs, 1995; Dunn, Griggs, Olson, Gorman, & Beasley, 1995). Research studies in distance education have linked field dependence/independence with academic achievement (Ching, 1998; and Powell et. al., 1994;). Learners who prefer a more structured learning environment are learners who prefer a dependent learning style (field dependent). These learners are less likely to succeed in a distance education environment (Powell.et.al., 1994;). As the degree of learner control of the distance education environment increases (or structure is decreased), dependent learners reported that they "got lost" when studying or were unsure of the instructor's expectations (Ching, 1998; and Gibson, 1996).

In a study examining the amount of learner control in a hypermedia environment, active (independent) learners performed best with high levels of learner control, and reflective (dependent) learners performed best with low levels of learner control (Rasmussen & Davidson-Shivers, 1998). In a study of forty-eight sixth-graders, a structured presentation of material facilitated learning better than an unstructured presentation of material when using computer based instruction (Yang & Chin, 1996).

In a distance education nursing program, a study demonstrated that a field dependent learning style is a good predictor of poorer academic performance (Ching, 1998). This study also demonstrated that development of field independence could be influenced by the curriculum and teaching approach. Ching compared the field independence of students beginning distance education study to their field independence at the end of one year of study and found that field independence increased in these students. Ching attributed this increase to the distance education environment on the basis that this distance education course was taught to isolated students that had no formal means of student-to-student interaction. However, many students did indicate that they created their own student study groups that would foster the field dependent students' learning.

Conclusion and Future Studies

Learning styles are a preference in how a learner interprets and processes information. Most of the learning style instruments measure learning styles in terms of binomial opposites (i.e., dependent/independent and verbal/visual). However, learning styles are not absolute opposites; they are measurements of a continuum between these binomial opposites. Learners prefer a certain mode of learning, and are not locked into one mode of learning. In the study of Chinese nursing students, it was demonstrated that a student's learning style could change over time (Ching, 1998).

One consistent finding in the research on learning styles in distance education was the outlook for the dependent learner. The independent learner was more likely to succeed in a distance education course or program than a dependent learner. The dependent learner may be a good predictor of poorer academic performance.

To date in distance education research, most of the studies in learning styles have used samplings of convenience.

Also most of these studies were conducted on students who chose to take the distance education course over a traditional course offered at the same institution. In general, independent students usually self-select to the distance education course while dependent student self-select to the face-to-face courses. With the use of distance education in universities to deliver courses throughout a system where students are distributed among campuses in different cities, the choice of taking a traditional face-to-face course may not exist. Therefore, future studies should examine the dynamics of learning styles when the student has no choice but a distance education course or program.

Addressing Multiple Learning Styles in Web-based Instruction

The purpose of this literature review is to report current research addressing how Web-based instruction and the technological capabilities of the World Wide Web have been used to meet the individual learning styles of students. This review will look at research in the areas of learning styles and World Wide Web technology.

The area of Learning Styles has been researched extensively throughout the past fifty years. Much of this research has been conducted in the traditional classroom setting. The majority of research supports matching the individual's learning style with a complementary mode of instruction. Researchers agree that learning styles represent the ways in which individuals interpret, process, understand, and integrate information. Learning styles are defined in many different categories and inventories, none of which are standardized across the research. This makes it difficult to apply general conclusions across the research findings. Since much of the research on learning styles supports teaching students to their individual learning styles, for greater academic achievement, and shows support for the need to address multiple learning styles in every instructional lesson, this literature review is not limited to any specific learning styles categories or inventories.

The research in the combined areas of learning styles and Web-based instruction is very limited. The research that has been reported used mainly undergraduate college students as samples. Little is known or has been reported about addressing learning styles in Web-based instruction, for K-12 students. This appears to be an area requiring further research.

Learning Styles

Extensive research has been conducted in the area of learning styles in the traditional classroom setting. A great majority of this research has supported the fact that each individual differs in the way they interpret, process, understand, and integrate information. Research shows that people exhibit significant individual differences in the cognitive processing styles that they adopt in problem solving and other similar decision making processes (Robertson, 1985). Individual differences in student learning are categorized into learning styles. Learning styles are the ways in which the brain interprets processes, understands, and integrates information. Dunn, Dunn, and Price (1989), state that classrooms need to concentrate more upon individual learning styles because students tend to learn and remember better and enjoy learning more when they are taught in a way that takes into account for their learning style preferences. When developing instruction to accommodate learning styles, the instructional developer must know what delivery mode best suits each learning style type. When applying learning styles to the curriculum, Dunn & Dunn (1978) state that students should be taught to their dominant learning style and then followed with their second strongest learning style. Auditory learners learn best when they listen, read, and then take notes. Visual learners learn best when they read, look at visual aids, took notes, and then listened to a lecture on the material. Tactile learners require manipulative materials in which they can use to construct and then read, write, and listen to the material. Kinesthetic learners prefer exposure to the real world, such as field trips, followed by reading, writing, and listening to the material. A case study, by Hodges (1982), shows how putting these learning styles strategies into action can increase student achievement. The study was conducted with Junior High school students, from extremely low socioeconomic backgrounds, who were not responding to conventional strategies for learning. Each student was given a Learning Style Inventory test and an individual curriculum was matched with the student's dominant learning style. Results indicate that eighty-five percent of the students substantially increased their achievement levels in reading and math compared with their previous performance in a typical school setting. The data revealed that, when learners are taught through methods that complement their learning style preferences, learners become more motivated and have higher academic achievement.

Robotham (1995) questions the practice of placing students into pre-specified learning style categories. The author believes that this causes students to become stagnant in their ability to understand how they learn. The author believes that forcing students to learn, using different learning styles, can help them grow. Snider (1990) also states that it is good practice to recognize and accommodate individual differences and to present information in a variety of modalities. This research shows support for providing instruction that addresses multiple learning styles, within one lesson. With the advanced technological capabilities of the World Wide Web, it is possible for students to have exposure to a variety of instructional delivery methods that can accommodate multiple learning styles.

World Wide Web Technology

Some current capabilities of Web development software and World Wide Web technology have allowed teachers to expand upon traditional text and lecture based classes by creating individualized lessons that are aligned with teachers' lesson plans and individual students' competencies and abilities. Some current Web development software tools include, Microsoft Front Page, Macromedia Flash, Hyper Studio, Claris Home Page, and Power Point. This Web development software also allows each student to meet his or her individual needs, by selecting a unique course of instruction, through non-linear, branching structures. Students can direct their own learning by pursuing their interests and organizing and synthesizing data and constructing projects that are meaningful and can be applied to real life situations. Ayersman and Minden (1995) state that hypermedia has the ability to deliver information in contextually meaningful sequences, at a variable pace controlled by the learner, through multiple sensory modalities. Summerville (1997) states that hypermedia holds great promise for the accommodation of individual differences. Hypermedia has the ability to be flexible or structured, provide varied feedback, and allow the user to access other resources.

Some of the current features in multimedia Web development include the use of audio, video, virtual reality, animation, and simulation. RealAudio provides music, news, and talk shows over the World Wide Web. Java is a programming language that lets Web page developers add software applications, games, animation, and other features to Web pages. Shockwave enables the playback of high-impact multimedia on the Web and Virtual Reality Modeling Language (VRML) describes how three-dimensional scenes are delivered across the World Wide Web (Serim & Koch, 1996).

The World Wide Web can be used to accommodate students with diverse styles in processing sensory information, such as visual, auditory, and kinesthetic learners (Ross, & Schulz, 1999). Visual students can benefit

from World Wide Web instruction that includes course animations, hypertext, or clickable diagrams and video clips. These images can clarify concepts that static textbooks cannot. Learners who have difficulty processing auditory information in a lecture could benefit from having the professor's lecture notes, slide presentations, or overhead slides online. Auditory learners can benefit from Web-based instruction by having professors record their lectures, record class summaries, or create archived sound resources and place them online (Ross, 1998). Kinesthetic learners can benefit from Web-based instruction by providing them with Java based puzzles, games and simulations. Providing a course listserv, bulletin board, discussion thread, or chat room can also accommodate collaborative learners (Ross & Schultz, 1999).

Lin and Davidson (1996) found that when using hypertext instruction, structure and cognitive style had a significant effect on student performance. Research has shown that learner control is an important factor when creating Web-instruction for diverse learning styles. Learner control is the amount of personal responsibility an individual can have in an instructional lesson. Learner control in Web-based instruction can be exhibited through sequencing, pacing, advisement level, practice, and amount of material (Rasmussen & Davidson-Shivers, 1998). In a study conducted by Rasmussen and Davidson-Shivers (1998), the influences of the individual differences in learning styles and the concept of learner control to assist instructors and developers in designing effective instruction for all learners were investigated. They hypothesized that learning styles can be used in conjunction with learner control to facilitate and enhance student performance in hypermedia learning environments. The study found that learning styles significantly influenced performance in hypermedia learning environments. Individuals who had a learning style preference towards active learning preferred low levels of learner control and performed best in the hierarchy structures. The hierarchical structures allowed students to quickly accomplish tasks, which fits the style of the active learner who prefers to complete tasks as quickly as possible. Individuals who were reflective in their learning style preference performed highest with moderate structure. The results show that reflective learners must have some structure but must also be provided with the ability to explore other related material. In addition, all learners performed well in an environment that provided moderate structure. This research suggests that environments with high levels of learner control may be counterproductive to all learning style types.

World Wide Web and Learning Styles

World Wide Web technology has the capability of meeting the individual needs of a variety of learner types within each Web-based lesson. Much of the instruction taught in schools benefits the auditory and visual learners. Other learning style types are often not focused on in the classroom. Although research on Web-based multimedia instruction and learning styles is extremely limited, the following examples have been found that support the use of Web-based multimedia instruction for meeting the diverse needs of learners. For example, tactile learners gain and attain information when they are given hands-on activities (Dunn & Dunn, 1978). These students can respond well to game-like activities that are naturally motivating and self-correcting. Students can use the self-correcting features to discover correct answers through inductive and deductive learning (Bruno, 1982). An example of a game activity that can be beneficial to a tactile learner is the microworld. A microworld is an exploratory learning environment, discovery space, and constrained simulation of real-world phenomena in which learners can navigate, manipulate or create objects, and test their effects on one another (Jonnassen, 1996). A study conducted by Stoney & Oliver (1999), explored the notion that students who learn in an applied setting, such as a microworld, will experience cognitive engagement and motivation through the relevance of the material to the student's real world. University students were selected and their activities, communication, and interactions were observed. Results found that the use of well-designed interactive microworlds leads to learner cognitive engagement and will drive learners towards greater levels of higher order thinking. The microworld game also provided motivation and engagement with the program content because it provided real life experience. The game helped learners to judge and assess the credibility of potentially conflicting information and to develop strategies to think critically, resolve conflicts, and solve current and potential problems.

The California State University Biology Labs On-Line Project (Bell, 1999) is a project that seeks to use technology for improving biology education. This project provides Web-based simulations for different Biology labs in which learners can access anywhere and anytime. Initial tests on the Biology project have suggested that the programs can be very useful learning tools. Students liked the way the simulations made them think, solve problems, and understand the breadth of the material better. The one disadvantage noted was that novice computer users require assistance to get the most out of the simulations.

An additional case study involving a college Engineering Graphics class, at the University of Texas, has used the World Wide Web to publish a comprehensive multimedia instructional CD-ROM Web page (Crown, 1999). The CD-ROM Web page consists of an integrated web site with links to hours of tutorial movies, lecture presentations, web-based games that reinforce course topics, and interactive web-based quizzes. The CD-ROM Web page was designed to make more efficient use of faculty time and to provide students with additional individualized

help. This project had many positive results on both faculty and students. Professors benefited by having their course lecture time reduced by eighty percent. Students who require extra help or need to make up work were able to catch up and perform well in the course. The visualization tools, provided in the games, offered students the opportunity to view objects repeatedly, which would be difficult to teach using other methods. Two noted drawbacks to the CD-ROM Web page include the high initial cost in time to develop the project and the fact that this environment has less student-to-student interactivity and is more impersonal than traditional classroom lab settings. The most notable changes in student performance were by those students that fell outside the average range. The advanced students were stimulated and motivated by the self-paced nature of the course and the students who found the material challenging were able to work at a slower pace and finish a course that they normally would drop.

Conclusion

Little Research has been done on addressing multiple learning styles in Web-based instruction. The literature shows strong support for matching learning activities with students' preferred learning styles. Web-based instruction allows for the development of instruction that can meet a variety of learning styles. It can address multiple learning styles within the same instructional lesson. Therefore, it is hypothesized that students will perform better and learn more from properly designed Web-based instruction that meets the many individual learning styles of students, than Web-based instruction that is linear and text based. Since World Wide Web technology and multimedia software is capable of supporting instruction that appeals to a variety of learning styles, and research suggests that students must also be exposed to other non-dominant learning styles, a Web-based instructional lesson that accommodates multiple learning styles should be ideal for enhancing student achievement. When addressing the no significant difference phenomena, the research presented in this literature review supports that there are significant differences in student achievement, in a Web-based environment, when instruction is developed using theories on the way students learn. In order to look beyond the no significant difference phenomena, Web instruction must go beyond the technology and look into how the technology can be used to deliver instruction to all students, each unique in their experiences and in the ways they learn. Integrating learning styles research into Web-based instruction is one way that may show a significant difference in achievement in Web-based instruction.

Application of Intelligent Agents in Web-based Learning Systems

How will the Intelligent Agents (IAs) and World Wide Web (WWW) architecture impact education in the future? Perhaps learning will resemble this imaginary encounter:

> The twelve-year-old girl enters a room containing a wall display and an electronic unit about the size of the obsolete desktop PCs of a decade ago. Her "learning center" is a voice activated intelligent appliance linked directly to a database via the new Information Superhighway.
>
> "Computer on," she commands.
>
> The computer synthesized voice responds, *Good morning Genevieve. School was to begin 27 minutes ago. Are you ready?*
>
> "Yes," she replies rather unenthusiastically.
>
> *I recommend beginning with Statistics. You are now one week behind your agreed schedule,* the course management agent continues.
>
> "Great!," the girl responds with even less enthusiasm than before.
>
> *I'm sorry. Is that an affirmative Genevieve?*
>
> "Yes"
>
> The display screen next shows the animated face of a dog wearing glasses (the girl's creation). *Genevieve, good to see you. Your reflective time is over. Are you ready to review your last exam?*, the animated persona smiles with lolling tongue awaiting the girl's voice response.
>
> "Not really, but OKAY Topper" (The girl's name for her animated tutor). She smiles as she emphasized the command word "okay."
>
> *You completed 30 of 50 questions correctly,* Topper continues.
>
> "I figured as much"
>
> The animated persona looks quizzical and responds, *Yes. Well, it appears that you are having difficulty relating the concept of the normal distribution to the concepts of standard deviation and confidence intervals. Do you want to review the material or try a new approach.*
>
> "I'll try the new approach." And the lesson begins.

At what point in the future will technology and software combine to produce the scene above? As prototypes and experimental models, this future is already here.

Alan Turing and Moore's Law

In a 1950 article, Computing Machinery and Intelligence, mathematician Alan Turing posited the question, "Can a Machine Think?" (Hodges, 2000). To Turing the question was: "If a computer could think, how could we tell?" He considered that if the computer's responses were indistinguishable from that of a human, could the computer be said to be thinking. Turing set a standard for determining intelligence or thinking by making a prediction. He postulated that within fifty years (i.e., the year 2000) an average person would not have more than a 70 percent chance of distinguishing between a computer or human responding to five minutes of questioning. Turing's imitation game has now become known as the Turing Test. In 1990 philanthropist Hugh Loebner agreed to underwrite a contest to implement the Turing Test. The contest is conducted each year by The Cambridge Center for Behavioral Studies (http://www.loebner.net/Prizef/loebner~prize.html). A grand prize of $100,000 and a Gold Medal will be awarded to the first person constructing a computer that passes the Turing Test. Although this prize has yet to be claimed, each year an prize of $2000 and a bronze medal is awarded to the individual constructing a computer program offering the most "human" responses.

In addition to software advances required to pass the Turing Test technology must also progress. Moore's Law is based on the observation that the logic density of silicon integrated circuits follows a mathematical curve. According to its author Gordon Moore (who co-founded Intel) the amount of information storable on a given amount of silicon has roughly doubled every year since the technology was invented. In the 1970s the rate of doubling slowed to 18 months, and Moore predicted that natural limitations would invalidate the "Law," but not until 2017 (Kanellos, 1997).

In a broader view both the Turing Test and Moore's Law are illustrative of the first steps toward an ideal where economical intelligent machines serve the needs of the individual. This paper will examine the development of intelligent agents and forecast applications for education deliverable on the World Wide Web (WWW).

Intelligent Agents

'Intelligent agent' as a concept has been around for about 25 years. An agent is a software entity that has some degree of autonomy, carries out operations on the behalf of a user or another program, and represents or has knowledge of the user's goals and wishes. Definitions approach intelligent agents based on how the term "intelligent" is defined. Science fiction genres tend to associate intelligent software with human-like emotional and mental processes such as knowledge, belief, intention, and obligation (Coen 1994). Utilitarian definitions of intelligent agents focus on a particular software's ability to function in some complex dynamic environment, and to sense and react autonomously to achieve a set of behaviors. Intelligent agents can also simulate worlds and operate in those simulated worlds interacting with the users and other agents. Information agent software searches multiple databases to retrieve, collate, filter, and organize information to answer queries from users (Shoham, 1993). A list of attributes of agents, not all of which need to be present in an agent, are:

- Autonomy – ability to operate without the direct intervention of humans;
- Social ability – can interact with other agents or humans by providing assistance to users dealing with another agent;
- Reactivity - have perception of their environment which allows timely response to changes that occur in it;
- Proactivity - exhibit goal-directed behavior (initiative);
- Mobility - can move to other environments;
- Reusability - agent algorithms run continuously;
- Adaptivity – will automatically adapt to changes in their environment; and
- Synergism - higher level of interoperability is made possible through the interaction of agents and humans as a system (Shoham, 1993).

There are many categories that research on intelligent agent systems and similar software applications have been subdivided. For example, adaptive learning systems, artificial intelligence, artificial life, biocybernetics, cognitive and neural modeling, evolutionary computation, fuzzy systems, genetic algorithms, knowledge-based systems, multi agent systems, neural networks, parallel and distributed computing, self-organizing systems are terms associated with the above attributes for intelligent agents. Furthermore, each of these categories is being researched for applicability to learning on the WWW.

Intelligent Agents and Tutoring Systems on the WWW

With the World Wide Web becoming an increasingly important platform for the delivery of educational content, instructional designers and researchers in artificial intelligence are reconsidering architectures that were

developed for stand-alone computer or local network applications (Ritter, 1997). Intelligent agents are being developed for many of the new applications (Johnson & Shaw, 1997). Areas of intelligent agent research that show promise for educational applications deliverable through the WWW are briefly described in this paper.

Intelligent Agents Used for Database Management and Information Retrieval

The WWW can be viewed as an extremely large database. This database is composed of heterogeneous documents that are accessed via a wide-area network (WAN) and a client-server protocol. These documents (nodes) are connected by hyperlinks. To retrieve information hyperlinks must be navigated and navigation becomes extremely difficult in the three-dimensional structure of the WWW (De Bra & Post, 1994).

Intelligent agents have the potential to search the vast volume of information on the Web in ways that are only now being explored. Agents have advantages of (1) robustness – available 24 hours a day, seven days a week, (2) speed – transmit information within seconds, and (3) value adding – the more sophisticated the agent in terms of design for ability to discover relevant information the more tangible the benefit from the information (Etzioni, 1999). Etzioni and colleagues at the University of Washington are researching and designing Internet Softbots (intelligent agent software) that will enable a user to specify personalized *wants*. The Softbot is designed to calculate the *how* and *where* to satisfy the request. Etzioni uses the metaphor of a food chain or pyramid to visually describe the role that a discriminating information agent would play in this new information "ecosystem" of the WWW. Developmental work is also being done by Etzioni's group on adaptive Web sites that automatically reconfigure their layout and presentation by analyzing user access patterns recorded in their server logs (Perkowitz & Etzioni, 1997).

Intelligent Agents and User-Friendly Interfaces for Databases

The use of an animated persona to communicate information has recently caught the interest of the news media. The highly publicized virtual newscaster Ananova (Hopper, 2000) is an example. Using streaming video Ananova provides the latest headline news. Facial expressions are cued by XML (eXtensible Markup Language) tags that are added to the script. Digital Animations Online (http://www.digital-animations.co.uk/) is the creator of Ananova.

Customizable animated intelligent agents. Customizable animated intelligent agents are available to Web developers to enhance the commercial value of a Web site. These virtual personalities can assist a visitor to the site in identifying products, guiding the visitor through product features and benefits, or even making the "sales pitch" and closing the sale. The animated persona can interact with the user by answering queries including the display of facial features ascribed to various human emotions. Animated personas are proposed by their developers as adaptable for use by educators.

Intelligent Agents Facilitating Collaboration in Online Courses

A significant problem experienced by students (as well as causing concern for instructional designers of online courses) is how to facilitate collaboration in a largely asynchronous environment. Typical problems expressed by students working as groups in a face-to-face environment are "lack of time, lack of skills and members not contributing" (Whatley, Staniford, Beer & Scown, 1999). These problems are made more manifest in collaborating groups separated geographically (Johnson, Aragon, Shaik, & Palma-Rivas, 2000). In order to facilitate collaboration intelligent agents are able to support planning through task allocation, progress monitoring, and problem flagging (with communication with the individual student as well as with the agents of other students).

O'Riordan and Griffith describe an multi-agent system design where several intelligent agents that the authors believe will overcome specific web-based education shortcomings in the areas of peer-peer learning, static content, and personalized learning (O'Riordan & Griffith, 1999). Their system design focuses on a User Modeling Agent that maintains the student profile. The profile consists of material covered and how fast its was covered, quiz score, frequency of links visited, and use of an FAQ section. Collaborative groups are based on multiple profiles.

Intelligent tutoring systems. An Intelligent Tutoring System (ITS) is designed to simulate what occurs between a student and teacher one-to-one. ITSs typically have four components: (1) an intelligent interface (communication), (2) a knowledge domain, (3) an instructional module, and (4) a student model (representing the student's current state of knowledge). Student modeling has been the most difficult due to the learner uniqueness and individual learning styles (Stern, 1997).

Most models of student behavior commonly used with intelligent tutoring systems (ITSs) or not designed to deal with such human inputs as inconsistency, incompleteness, and ambiguity. Often this "fuzziness" of human input results in an inability of the ITSs to correctly evaluate student answers. Huang approached this problem by developing a model that incorporates fuzzy set theories and two-dimensional (Hasse) diagrams to provide more accurate feedback to incomplete student answers (Huang, 1999). The learning agent captures inconsistent behaviors of the student. A student's inconsistent response, for example, triggers the learning agent procedure that uses a inconsistency identifier. The inconsistency identifier is based on a heuristic, such as on the same or similar question

the student's answer is now incorrect. The feedback from the learning agent then displays features of the inconsistencies and provides suggested strategies to prevent the behavior from happening again.

Animated pedagogical agents. Animated pedagogical agents are designed to facilitate learning in computer-based instruction, and also have been applied to Web-based intelligent tutoring systems (Rickel & Johnson, 1997). Typically, animated agents have personas that can exhibit emotive-kinesthetic behaviors responding to user input within the program (Lester, Stone & Stelling, 1999). Pedagogical agents are built upon ITS research, but have the added requirements of coordinating the agents behavior with personality cues that relate to student input (Lester, Towns & FitzGerald, 1999). Animated agents can provide real-time advice that supports a learners' problem solving activity, but can also exhibit contextually appropriate emotive behaviors such as facial expressions and gestures. Lester, *et al* identify two key problems with representing emotive behaviors are conversational believability and emotive believability, and have developed a dialogue mapping framework to achieve conversational believability and full-body emotive behaviors in response to learner problem solving activities to achieve increased emotive believability.

An example of a prototypical animated intelligent agent is was developed by Andre, Rist, & Muller (1997). Their agent did not involve speech, but with animated gestures and text interacted with the user. One unique feature of their animated agent was that the presentation scripts and navigation structures were not storied, but generated just-in-time from pre-authored document fragments.

Adele (Agent for Distance Education) is an example of a more sophisticated animated pedagogical agent developed by researchers at the Center for Advanced Research in Technology for Education (Shaw, Johnson & Ganeshan, 1999). Adele was specifically designed to support online students in problem-solving exercises with a simulated patient in a clinical setting. Students are able to ask questions regarding the simulated patient's medical history, perform a physical examination, order diagnostic tests, and make diagnoses. Adele also provides the student feedback relative to the actions chosen by the student in the form of suggested correct actions, or hints and rationales for particular actions with reference to relevant background material. In this autonomous agent design, Adele consists of two sub-components: the animated persona (a Java applet) and the reasoning engine. The reasoning engine performs all monitoring and decision making activities. Decisions are based on a student model, the case design, and the initial state of the case. All this information downloaded from a server when as the student selects the case. Initial student evaluations of Adele concluded that the hints and rationales provided by the animated agent were helpful, but not complete. However, this appeared to be a function of the students not interacting with the persona, for example, asking "Why?" The agent was capable of accessing more authored knowledge. This problem was remediated by allowing the agent to provide more of an explanation.

Conclusion

The significance of intelligent agent systems on the WWW will probably eventually be best understood in the context of a paradigm shift. The combination of technology in terms of software and hardware, and the delivery and accessibility afforded by the WWW, is creating an environment of change. The impact of change on institutional or traditional education is in the infancy of exploration.

Web-based educational systems represent an area that growing exponentially with educational technology research and software development leading the way. Pedagogical aspects such as instructional design theories and models have lagged behind (Tergan, 1997). In many respects the situation facing educators is similar to the company that designs a product and goes out to find a market for it. The technology is driving the process and instructional theory and design are attempting to "find the market."

This situation may be due to the fact that much of the developmental research work on Web-based IA software being done for commercial objectives. Major efforts in IA research and design are directed toward e-commerce applications on the WWW. Software agent technologies are being investigated to expedite the electronic commerce revolution. E-commerce development issues, such as distributed component-based marketplaces, protocols for locating and defining goods and services, value-based product comparisons, buying decision aids, visualization of marketplace data and activities, have pedagogical counter-parts in education.

Intelligent agent systems that support student collaboration, support problem solving, and explain errors will certainly be a first step. How will Web-based distance education benefit from this development? The development of quality databases on the WWW coupled with the development of intelligent agent software that can retrieve personalized information. Will a student having greater access to knowledge be a better learner? What instructional designs will be necessary? Are animated personas described in this paper, that guide a student through a lesson or topic, an advantage to learning or a distraction? Opportunities abound for the researcher in both the design and in the development of instructional models that incorporate intelligent agents and the WWW.

Summary

The four approaches presented here support the need for continued exploration of distance education from new perspectives. The use of CAI is not new. However, the use of CAI as the technology of choice for distance education in the K-12 setting has potential. CAI's capabilities of individualizing instruction and providing asynchronous instruction combined with the richness of the World Wide Web need further exploration as an effective and cost efficient means of providing access to educational opportunities for K-12 students.

More studies into learning styles of distance learners are needed that control for the problems identified in the current literature in this area. Sampling needs to be moved from simply relying on convenience sampling. In addition, standardized instruments need to be developed to examine this learner attribute. Designer's of distance education need to address the needs of the dependent learner and student support services developed to assist these learners in having success in the distance education environment. When reviewing learning styles and web-based instruction, there appears to have been little research. From a design perspective can and should web-based instruction be designed in such a way to accommodate all learning styles?

New technologies are constantly emerging. How will the use of intelligent agents impact the learning environment particularly distance education? Instructional technology has a tendency to lag behind technology advancements. Exploring the utilization of intelligent agents to support student collaboration, problem solving and provide assistance in the distance learning environment would be one step toward closing the gap.

Certainly, thinking of distance education research only in terms of the no significant difference does not represent the wealth of research that is occurring in the field. However, as researchers we can do more by looking beyond the conventional, looking at new uses for current technologies, and exploring the potential of emerging and future technologies.

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Identification and Analysis of the Leading Journals in the Field of Educational Technology: A Guide for Reading and Writing about Educational Technology

Nancy J. Maushak
Robert Price
Hsi-Chi Wang
Texas Tech University

Abstract

This article reports on a study conducted to identify and analyze the content of the five leading journals to assist those reading, teaching and publishing in the field of educational technology. Email was used to contact professionals in the field. They were asked to identify the top five journals in educational technology. Results were summarized then the leading journals were reviewed for content and number of articles. ETR&D was identified as the leading journal in the field. The content and type varied from journal to journal based on the overall goals and intended audience of the journal. Suggestions for writing and publishing are included.

Introduction

Research, teaching and service continue to be the three pillars supporting recognition, promotion and tenure in the academic world. For many, the greatest contribution is research. Research, theory and changing paradigms must be communicated to the field in order to make a positive contribution. This is as true for educational technology as it is for other academic areas. Publication therefore becomes a primary role for the novice as well as the experienced professor and for the graduate students they mentor.

The process of publication seems at times almost mystical. Young professionals tend to be intimidated by the whole idea, especially the prospect of rejection. They view successful scholars as possessing great wisdom and intellect when in reality they could be more accurately characterized as persistent, systematic and, sometimes, just plain lucky!

This article provides a background of the literature in educational technology related to publication and presents results of an informal study which identified and analyzed the top ranked journals in the field. This information should be of use to both novice and experienced scholars and as they share their research, knowledge and expertise in the field of educational technology.

Background

Publication has always been and continues to be of great interest for scholars, researchers, and graduate students because it is the road to making a contribution to the field and contributing to their personal goals of professional advancement. A review of the literature related to publishing in the educational technology field yielded some interesting findings.

Ninety percent of the articles identified discussed general publishing principles. Thompson (1995) complied a what-to-do list, and Newren (1992) contributed a list of major causes of rejection for writers to consider before and after they send in their manuscripts to a journal publisher. Abelson (1990), the editor of the journal *Science*, talked about his experiences in evaluating submitted manuscripts. He believed in the value of peer review, and tried to caution writers to beware of any unethical behaviors such as plagiarism.

Newren (1992), Thompson (1995), Clemente, Shapiro, Miheim, and Bohlin (1990) each summarized vital information of the many different journals in the educational technology field. Types of information presented included contact information, acceptance rate, readership, decision time, publication time, etc. These summaries are useful for prospective authors to help them familiarize themselves with different journals in order to more effectively select a journal for manuscript submission. Yet, not one of these articles examined the types or topics of the articles actually published in the journals. Thompson (1995) suggest that all perspective writers should look into the matter of finding the types and topics patterns in addition to identifying the guidelines for authors of the journal they have selected to send their manuscript. This step is vital to the process of getting a manuscript accepted by the specific journal.

The review of previous articles related to scholarly publication in the field of educational technology identified a need for a study that identified information about types and topics of articles in the top ranked

educational technology journals to assist scholars in selecting the best match for their manuscript and to help them recognize the current trends and future direction in educational technology. This study attempts to fill that need.

Methodology

An email survey was used to identify the top five journals being read by educational technologists. Websites of nine schools with nationally recognized programs in educational technology were used to identify faculty in the field. An email message was sent to 85 faculty members asking them to list in rank order the top five journals. In addition, they were asked to respond with one piece of advice for those just starting to write for publication.

An analysis of the 1998-1999 issues of the top journals was conducted to identify the average number of articles per publication, general types of articles, and topic categories of articles. Four categories for classification of journal articles were identified by Klein (1997) in a review of *Educational Technology Research and Development.* These categories included case study, description, empirical research, and literature review. For this study, these categories were revised to include descriptive, research, book review and editorial articles.

Topic categories of articles emerged from the analysis conducted by two researchers. Categories were not exclusive but topics were placed under the theme that best reflected the intent of the article. Four broad themes emerged from the review: design, environment, student, and teacher. A fifth category (other) was used for additional topics that either encompassed several categories or seemed to fit none of the emergent themes.

Where possible, actual copies of the journal were used for review purposes. The use of on-line databases including ERIC and Education Abstracts facilitated the review process.

Results

A total of 30 responses were received to the email survey with each school represented by at least one faculty member. Five of the responses simply indicated the individual was no longer in the field or had moved to another institution. Responses from the remaining 25 (31% response rate) were summarized to identify the top five journals. A total of 31 different journals were identified. *Educational Technology Research and Development (ETR&D)* was ranked first or second by 18 of those responding.

The Big Five

To identify the top five journals, responses were assigned values based on rank. The number one journal listed by an individual received a score of five with others in descending order. Scores across all responses were summed and journals with the highest values were identified. The top five journals in order with their scores were:

Educational Technology Research and Development	91
Performance Improvement Quarterly	35
Educational Technology	31
Journal of Educational Computing Research	29
Instructional Science	28

Types and Topics

An understanding of the number of issues and number of articles published on a yearly basis can be one factor in selecting a journal for publication (Table 1). Three of the five top journals are published quarterly. In the subscription information, *Instructional Science* indicates it is published six times a year. A review of the actual citations and abstract seems to indicate that while six numbers are used for each volume, only four actual publications could be located. Numbers 1 and 2, and numbers 3 and 4 for both 1998 and 1999 were found to be combined into one issue.

All articles including introductions to special issues and book reviews were counted. The average number of articles per year per journal varied from a low of 25 to a high of 62 (Table 1). Similarly, the average number of articles per issue varied from just under six for *Journal of Educational Computing Research* to almost 10 for *Educational Technology.*

Table 1: Summary of Average Number of Articles per Issue of the Top Five Journals.

Journal	Number of issues per year	1998 articles	1999 articles	Average per issue
Educational Technology Research and Development	4	36	40	9.5
Performance Improvement Quarterly	4	37	40	9.6
Educational Technology	6	57	62	9.9
Journal of Educational Computing Research	8	49	43	5.8
Instructional Science	4 (6)*	25	31	7

*Publisher indicates six issues are published yearly, however issues 1-2 are combined as are 3-4 resulting in only 4 publications a year

Simply knowing the numbers of articles per publication is not enough to select a journal for publication. It is also important to know what types of articles are generally published. Four general categories (Descriptive, research, editorial, and book review) were used to review all five journals. Descriptive articles had the greatest diversity and included description of theory, practice, models, curriculum, etc. Research encompassed articles reporting empirical research (both quantitative and qualitative) and evaluation. Introductions and conclusions to special issues were included in editorial articles.

Our review indicated that descriptive articles were in the majority and articles reporting results of research were second (Table 2). Three of the top five appear to have a good balance between research and description though all three publish more descriptive articles than research articles. *Educational Technology* focuses almost exclusively on descriptive articles and the *Journal of Educational Computing Research* leans heavily toward publishing more research articles.

Table 2: Summary of Types of Articles

Journal	Descriptive	Research	Editorial	Book Review
Educational Technology Research and Development	40	27	7	4
Performance Improvement Quarterly	43	22	8	2
Educational Technology	109	9	1	0
Journal of Educational Computing Research	15	63	1	13
Instructional Science	33	20	6	0

The third factor we looked at when reviewing the top five publications related to topics. A constant comparative method was used to identify themes of article topics. The four emergent themes were design issues, environment issues, student attributes, and teacher concerns and attributes. The following section presents a summary of article topics organized by journal. An overview of each journal presenting mission and goals, and subscription information is also included.

Educational Technology Research and Development (ETR&D)

ETR&D is a scholarly journal published quarterly be the Association for Educational Communication and Technology (AECT). Each issue includes two sections: one devoted to research, both practical and applied, and one to design and development issues. Issues frequently include book and international reviews as well as research abstracts (http://www.aect.org/Pubs/etrdweb/etr d.html, July 12, 2000). Cabell's Directory of Publishing Opportunities in Education, 5th Edition (1998) indicated ETR&D had a circulation of close to 5,000 and an acceptance rate of 11-20%.

Volumes 46 and 47 of ETR&D, a total of eight issues, were reviewed for this study. The large number in the design category are representative of the development section of the journal. Several sub-theories of design emerged including:

- Theory and models (systems theory, ARCS model, constructivism, activity theory);
- Media and attributes (authoring systems, multimedia, ILS, digital manipulatives);
- Design principles (needs assessment, evaluation); and
- Learning and cognition (knowledge management, user-design, cases, cognitive approach, design experts).

The primary topic under environment issues was interaction. Interaction related topics included learning communities, cooperation, and electronic classrooms. Other environment topics were accessibility, support and organizational complexity. Student attribute topics included achievement, recall and transfer, preferences, and reflection. Topics related to teacher focused heavily on teacher preparation but also looked at planning, methods, management, and support issues.

Because of ETR&D's focus on research, the prime category that did not seem to fit any of the themes were topics related to research issues. These topics related to changing paradigms and theories, and research methodologies.

Performance Improvement Quarterly (PIQ)

Bob Mager on the PIQ website (**http://www.fsu.edu/~lsi/piqweb/**, July 12, 2000) provides insight into the focus of PIQ with the following quote:

> Serious researchers in various corners of performance technology will find PIQ a scholarly source of current research by some of their more notable colleagues. Practitioners will find thought-provoking reports about leading-edge ideas and techniques that may influence their practice. If you're serious about performance technology, you should be reading Performance Improvement Quarterly.

PIQ is a quarterly publication of the Learning Systems Institute of Florida State University in cooperation with the International Society of Performance Improvement.

Volumes 11 and 12, numbers 1-4 of *Performance Improvement Quarterly*, a total of eight issues were reviewed for this study. There were three special issues during this time: global distance learning, diversity, and action learning. These topics also appeared in the regular issues.

It was more difficult to fit the topics in *Performance Improvement Quarterly* into themes. The focus of these articles was on the corporate/business environment. Articles related to instructional design were featured in almost every issue. A variety of ID models were described and research results related to emerging models of design were presented. Environment related issues also appeared prominently. The distance learning environment was featured frequently and included topics related to international distance learning, delivery systems, history and definitions. Student issues included performance/achievement, transfer, perceptions, and lifelong learning. Little coverage was given to teacher topics. Cost benefit and analysis appeared frequently as did topics related to diversity.

Educational Technology

Educational Technology is a bi-monthly publication with a readership of 3000-4000. Manuscripts are reviewed in-house with an acceptance rate of 21-30% (Cabells, 1999). This journal does not focus on research articles but has a more general slant. "The editors are looking generally for articles which *interpret* research and/or practical applications of scientific knowledge in education and training environments" (http://www.lbcoyote.com/resource/pub/edutech.html). A big plus with this journal for authors is the turn around time. Notification of acceptance is usually only a couple of weeks versus the months of waiting that accompany submission to other journals.

Volumes 38 and 39 were reviewed for this study. One special issue "Integrating cognition and affective domains of learning" was identified; and two special sections: "Return on investment in educational technology" and "Intelligence tutoring and learning environments". The articles included in *Educational Technology* have a more conversational tone than the articles found in the other journals reviewed for this study. Articles also tended to be shorter and included a greater variety of topics and viewpoints.

Design and environment themes tended to dominate. Design sub-categories were similar to those found in ETR&D, however the topics included in the sub-categories were more varied. Examples include:

- Theory and models (systems model, social systems, interactive model, conversational paradigm, alternative paradigms, postmodernism)
- Media and attributes (PowerPoint, multimedia, simulations, expert systems, ILS, games, WWW, screen design)
- Design principles (usability, feedback, planning); and
- Learning and cognition (independent learners, affective domain, discovery learning).

Environment interaction issues focused on the virtual classroom, virtual events, online education, community of practice, and international collaboration. Other environment topics included educational reform and specific environments of distance learning and Internet.

Student themes fell into two categories: learning and achievement including future skills and information literacy skills; and characteristics such as gender differences, mental models, and self-regulation. Few article topics

seemed to address teacher issues or characteristics. Other topics included in *Educational Technology* were systemic change, diversity, federal policy, and future visions.

Journal of Educational Computing Research

Baywood Publishing publishes this journal eight times a year. Articles include both practice and theory with an emphasis in four broad areas: 1) outcome effects of educational computing applications, 2) design and development, 3) research, and 4) foundations in educational technology (both theory and historical).

> The Journal's editors view the term "education" in its broadest sense. The use of computer-based technologies at all levels of the formal education system, business and industry, home-schooling, lifelong learning and unintentional learning environments, are examined.
> (http://www.baywood.com/site/new2/viewbook.cfm?id=100133&c=, July 12, 2000)

According to Cabell's (1998), the *Journal of Educational Computing Research* has a readership of approximately 1000 with an acceptance rate of 11-20%.

The primary theme that emerged from a review of the topics in volumes 18-21 of *Journal of Educational Computing Research* was student attributes. Three sub-categories were identified:

- Student learning (achievement, prerequisite skills, critical thinking and problem solving);
- Learning and cognitive styles; and
- Characteristics (attitudes, perceptions, anxiety, self-efficacy, gender differences).

While student themes dominated, the other three themes were well represented. Design topics focused on theory and models and media attributes. Interaction and cooperation were the leading topics related to environmental issues. Teacher attribute topics included perseverance/confidence, learning styles, and beliefs.

Additional topics included culture and social/ethics issues. Both culture from a technology environment viewpoint and an international viewpoint appeared in many issues. Social/ethic issues included equity, access and copyright issues.

Instructional Science

Unlike the previous journals, the focus of this journal is not on technology but on learning. *Instructional Science* is an international journal of learning and cognition published six times a year by Kluwer Academic Publishers. "The primary aim of *Instructional Science* is to promote a deeper understanding of the nature, theory and practice of the instructional process and of the learning to which it gives rise." (http://www.wkap.nl/journalhome.htm/0020-4277, July 12, 2000).

We reviewed eight issues of *Instructional Science,* Volume26 Number 1-6 and Volume 27 Number 1-6. The numbering system used is misleading. Number 1 and 2 were included in one publication as were numbers 3 and 4. In the two-year time period there were four special issues: generic tutoring environment (GTE), metacognition, use-system interaction, and didactics. Each special issue included at least one editorial as an introduction to the special issue and some also included concluding comments.

Topics reviewed student issues/attributes and design issues. Student topics included:

- Achievement including performance and vicarious learning;
- Characteristics (self-regulation, motivation, reactions, attitudes, cognitive styles); and
- Processing (metacognition, knowledge construction, cognitive processing).

Tools to assist in the design process, such as authoring tools and newly developed design software, were included in design issues. Also included in this theme were specific media and media attributes such as user-interface. Environment issues and teacher issues received limited attention.

Summary of Journals

ETR&D received overwhelming support as the leading journal in the field of educational technology. The average number of articles included in each issue was 8.5. The types of articles and topics covered varied greatly from journal to journal and appear to be dependent on both the mission of the journal and the intended audience. Authors should carefully review journals to identify those that most closely match the content of their article and the audience they are trying to reach. Journals should also be reviewed to identify the dominant writing style and take that into consideration when selecting a journal for publication.

Advice for Authors

The second part of the email survey focused on the process of writing for publication. A review of previous articles on writing for publication in the field of educational technology seemed to focus on identifying and targeting a journal and the submission process. Newren (1992) contacted editors and summarized the many causes for rejection. Both Clemente, et.al. (1990) and Thompson (1995) emphasized the need to concentrate on writing style, targeting a journal and following submission guidelines.

This survey was interested in more personal suggestions. Frequently the most difficult part of writing is the process. While not all individuals responded to the call for suggestions for those beginning a publication career, the suggestions that were received focused more on the process of writing rather than the submission. Twenty individuals responded to "What one suggestion would you give a doctoral student or faculty member just beginning his or her writing for publication career?".

Three themes seem to emerge with analyses of the responses: work with a mentor, believe in yourself and what your are researching, and write frequently. Several suggested that the individual just getting started work with a mentor or collaborates with a faculty member.

"Apprentice under/collaborate with a faculty member who has established an understanding of the processes, strategies and priorities of publishing scholarly research."

"Find a mentor willing to read your papers and provide you with constructive criticism prior to submitting them for publication."

Others felt it was important to not only believe in what you are researching but to believe in yourself.

"Believe in yourself and believe that your ideas and your information are good. People just starting out tend to think that everyone else in doing great things but that their own work is trivial....that's a shame because so many people are doing great, interesting things but they never share it with anyone because they are embarrassed or they don't think it's good."

Still others felt that it was important to concentrate on one or two projects at a time and to write every day.

"Write every day. Work on thins slowly and steadily over time, reserving the most creative and productive time of day for writing time."

Certainly paying attention to detail and selecting an appropriate journal for submission are important. However, there is more of a personal side to the writing process and this was emphasized by those responding. Attitude and persistence are important. Making time for writing, not simply "finding" time, and collaborating with others are instrumental in becoming a successful writer. Perhaps, most important of all is belief in yourself and what you are writing. With the fast changing world of technology, exciting research is going on and all have something important to contribute to the discussion.

Conclusion and Recommendations

The purpose of this study was to identify and analyze the leading journals in the field of educational technology. While the top five journals all examine technology, they represent disparate views in the field and address a wide audience. The journals are all unique in their goals and mission, writing styles, and intended audience. Certainly, anyone in the field of educational technology would benefit from reading any of these journals but would gain a much broader and more balanced sense of research, theories, and visions from reading several. Collectively they provide a wealth of information to assist the researchers in identifying problems and areas of study needed to make a contribution to the growth of the field of educational technology.

In some cases, the topics presented in the articles are very similar. However, an article on distance education, for example, would need to be written quite differently to submit to *ETR&D* than to submit to *Educational Technology.* The general summaries presented here serve only to provide a concise look at the myriad of possibilities for publication in the field of educational technology. It is imperative that those preparing manuscripts actually review the journal they have selected for submission

It should also be noted that research articles do not constitute the majority of published articles. Frequently, novice writers make the false assumption that only results of empirical research will be published. There are many opportunities for publication of articles describing projects, special instructional methods, new models and paradigms, and future visions. Topics are only limited by the experiences, imagination, creativity and interest of the writer.

Practice in writing, as with all things worth doing, is important. The experts represented in this study as well as colleagues we have visited with indicate the importance of writing on a regular basis. Frequently, in the day to day workday, other activities take precedence over writing. Time should be blocked out for writing as a scheduled activity and care should be taken to guard and use that time to polish the skills needed for successful writing.

In summary, while the response rate to the email survey was lower than hoped for, the responses did represent what practitioners in the field of educational technology are reading and which journals were most respected by a broad group of leading professionals in the field. *ETR&D* was emphatically identified as the leading journal in the field of educational technology. Broad categories of topics emerged from a review of the top five journals. These categories (with some examples) include:

- design issues (models, theory, principles, media, and media attributes);
- student issues/attributes (achievement, learning styles, attitudes, perceptions);
- environment issues (interaction, collaboration, international); and
- teacher issues (pre-service teacher, confidence, attitudes, methodology).

Dissemination of research in educational technology is the responsibility of all professionals in the field. Publication in recognized journals contributes to the growth and recognition of educational technology. The information discussed in this article provides a base for selecting a journal for publication. It is up to each individual author to provide the personal side of creativity, dedication, and perseverance.

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Preparing Teachers for the Inclusive Classroom: A Preliminary Study of Attitudes and Knowledge of Assistive Technology

Nancy J. Maushak
Pat Kelley
Teresa Blodgett
Texas Tech University

Abstract

The purpose of this study was to examine current attitudes and knowledge of pre-service teachers towards assistive technology and to develop, implement, and evaluate a mini-workshop on assistive technology to better prepare regular classroom teachers for the inclusive classroom. A pre-post survey design was used. Data from the pre-survey provided demographic information as well as documenting current attitudes and knowledge. Participants were 168 students enrolled in a computer applications course for elementary teachers. A mini-workshop on assistive technology was presented by experts in the field. Data was analyzed to determine impact of the mini-workshop on attitude and knowledge and to detect differences based on completion of a diversity course, having a disabled family member and having a disabled friend. Results indicated a continued need to include assistive technology under the broader umbrella of technology in teacher preparation programs.

Introduction

During the past decade, the demand for technology literate teachers has increased dramatically. Both the government and the public support the need for excellence and equity in technology integration, though, funding opportunities to support technology related professional development have focused on the in-service teacher. Technology experiences for pre-service teachers have centered around one basic class, usually computer based, and limited modeling by a few innovative methods instructors. The content of the basic course, too frequently, focused heavily on computer skills and minimally on integration of technology. Little if any reference was made to assistive technology and appropriate application in the regular classroom.

This paper presents the results of a preliminary study to evaluate the use of a mini-workshop on assistive technology presented by special education experts intended to assist pre-service teachers in developing an awareness of the variety of assistive technologies available and the teacher's role in using these devices or equipment in the regular classroom.

Background and Purpose

Mention the word technology to someone today and the first thing that comes to mind is computers and the World Wide Web. However, when it comes to education, that is too narrow of definition. In teacher preparation programs, students used to be required to take a media class that addressed a variety of technologies from 16mm films to overhead projectors to computers. Because of the technological advances in the past ten years, these classes have evolved to where the primary focus is currently on computer use and curriculum integration. Students have little exposure to other effective and appropriate technologies that can be used in the regular classroom to promote and enhance teaching and learning. One major category of technologies has been virtually ignored, assistive technology.

First, it would seem appropriate to provide a definition of assistive technology or AT. The following definition appeared in the Technology-related Assistance for Individuals with Disabilities Act of 1988 or the Tech Act (P.L.100-407) and has been adopted in the Individuals with Disabilities Education Act (IDEA, 1990). Assistive technology is "any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities." [20 U.S.C. Chapter 33, Section 1401 (25)]. As you can see, this definition is broad and can encompass a range of devices from low technology to high technology items as well as software. It certainly expands the interpretation of technology beyond the computer to include even simple tools that can be used to enhance learning for all individuals.

The 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA) mandated that students with disabilities learn and be evaluated with their peers (Goldberg, 1999; Derer, Lewis, & Rieth, 1996; Lewis, 1998). With this mandate, more school districts are implementing inclusion of students with disabilities into the

regular classroom. This in turn has created greater need for awareness of instructional methods and assistive devices to help these students become a productive member of the classroom with a minimum amount of disruption.

Previous research in the area of assistive technology and teacher preparation appears to be very limited (Derer, Polsgrove & Rieth, 1996). There was discussion of the needs in this area and some suggestions as to how to address this need, however, very few of the articles reflected an actual implementation of in-service and pre-service training in assistive technology for administrators, teacher and other school personnel. For example Bryant, Erin, Lock, Allan and Resta (1998) discussed the need for higher education faculty responsible for special education teacher preparation programs to explore ways to better prepare teachers to work with students using assistive technology devices but did not address this same need for "regular" classroom teachers.

In the inclusive classroom, assistive technology can provide support for both students and teachers (Mebler, Hadaian & Ulman, 1999). However, in order for this to happen both the student and the teacher must understand and know how to use the devices. Planning and policy at all levels, (classroom, school and district) are essential to achieve this.

It appears that regular classroom teachers are not currently receiving knowledge and skills related to assistive technology. One way to address this need is at the pre-service or teacher preparation level. The International Society for Technology in Education (ISTE) is the professional education organization responsible for recommending guidelines for accreditation to National Council for Accreditation of Teacher Education (NCATE) for programs in educational computing and technology teacher preparation. Included in the recommended foundations in technology for all teachers are two standards that point to the need for assistive technologies to be included in the teacher preparation program. First, beginning teachers should be able to "plan and participate in activities that encourage lifelong learning and promote equitable, ethical, and legal use of computer/technology resources" (ISTE, I.B). In addition, they should be able to "demonstrate awareness of resources for adaptive assistive devices for student with special needs" (ISTE, I.B.5).

The ISTE foundation standards guide the activities and instruction in the Applications of Technology in Elementary Education Course. This is an undergraduate teacher preparation class that engages the student in the use of technology as an educational tool. Opportunity is provided for students to explore and utilize technology applications that enhance the teaching and learning process. Emphasis is placed on the design, development and delivery of effective communication and learning activities. Until fall, 1999, the standard related to assistive technology was not addressed. This study looks at an effort to assist pre-service teachers in achieving an awareness of assistive technology, the appropriate application of AT in the regular classroom, and the role of the classroom teacher in using assistive technology to enhance teaching and learning for all students.

<u>Purpose</u>

Very little supporting research for the incorporation of assistive technologies into the teacher preparation program for regular classroom teachers was found in a review of the literature. Therefore, a decision was made to conduct a preliminary study to determine the students' knowledge of and attitudes toward assistive technology.

The purpose of this study was three-fold. First, researchers were interested in identifying pre-service teachers current knowledge of and attitude toward assistive technology. If the ISTE standard related to assistive technology is to be achieved, than a knowledge of current status related to this standard must be assessed to establish baseline data. Second, it was important to assess the impact of a mini-workshop on both knowledge and attitudes. Similar to the majority of pre-service method classes, time restraints and current curricula needs in the Computer Application class restricted the amount of time that could be allotted to this topic. There was a need to discover if the mini-workshop approach would be an effective means to assist students in achieving the minimum standard related to assistive technology. Last, instruments and procedures needed to be evaluated for their potential use in future studies. The inclusion of assistive technology into the pre-service teacher education program was a much-neglected area of study. Both instruments and procedures that are valid and reliable needed to be developed to further this field of study.

Methodology

A pre-post test design was used for this study. The class instructor conducted survey administration. At the beginning of the class period, participants were asked to complete the pre-survey. After surveys were collected, two experts in the field conducted a mini-workshop on assistive technology. A diverse sampling of assistive technologies were presented and discussed. Students had the opportunity to interact with the technologies shown and to ask questions of the two experts. The entire time allotment for both the pre-survey data collection and the mini-workshop was approximately 80 minutes. Within two weeks during another class period, students were asked to complete the post-survey.

Mini-workshop

The mini-workshop began with a review of the definitions of assistive technology and the Tech Act. Various low and high tech devices were shown, demonstrated when applicable, and applications for specific disabilities were identified. The students then had the opportunity to handle and explore the various devices. Other options for assistive technology were briefly reviewed. Emphasis was placed on the role and responsibility of classroom teachers to make their classroom accessible. Assistive technology can provide the means for accessibility for some children with disabilities. Students had the opportunity to ask questions throughout the workshop and were encouraged to talk with the presenters individually and examine the technology in more detail at the conclusion of the workshop.

Instrument

The instrument used for this study was adapted from an instrument with known validity and reliability previously used by one of the researchers. While the original instrument was not appropriate for use in these circumstances, it did provide guidance in the selection of items to include that addressed attitude and knowledge related to assistive technology. Using this instrument as a guide, a special education professional and an educational technology professional worked together to develop a 20-question survey for this study. A total of 20 questions were designed to measure students' knowledge of and attitudes toward assistive technology and students with disabilities. A six-item Likert scale from strongly disagree to strongly agree was used as a response set. In addition to the 20 Likert scale items, the survey included demographic items to describe the population. Three additional variables were also investigated. They were:

1. Completion of a required course on diversity,
2. Having a family member who is disabled,
3. Having a close friend who is disabled.

Both professionals reviewed the instrument and both contributed to revisions to insure content validity. Once data was collected, a reliability analysis was conducted. Using all 20 items on the survey, the instrument had a reliability coefficient of .71 using the Guttman split-half. To somewhat control for the short length of the instrument reliability was recomputed using a split-half corrected by Spearman-Brown prophecy formula resulting in a reliability coefficient of .72. This was still in the low range but of some value as this was a preliminary study and the instrument was only being used for group measurement and not individual measurement. Reliability results indicated that before further data is collected revisions should be made in the survey instrument to improve reliability.

Participants

A convenience sample was used for this preliminary study. Participants in this study were the students enrolled in a Computers Application for Elementary Teachers class during the 1999-2000 school year. There were five sections of this class each of the two semesters. A pre-post design was used. One hundred sixty eight students completed the pre-survey; 154 students responded to the post-survey.

Information collected on the pre-survey was used to describe the participants. The majority of them were female(85%), juniors (78%), and 20-21(72%) years of age with an age range from 19 to 44 years. Almost three-quarters (73.1%) had completed the diversity class. About one-fourth had a family member who was disabled (24%). Similarly, approximately one-fourth had a friend who was disabled (23%).

Results

Data were analyzed three ways. First pre-survey frequencies were reviewed to identify current attitude and knowledge and to identify areas of concern. Second, post-survey responses were analyzed to see if the same areas of concern held true after participants completed the mini-workshop. Finally comparisons in mean scores were used to detect differences between pre and post as well as differences in current attitudes and knowledge based on independent variables: diversity class, disabled friend, and disabled family member.

Pre-Survey

Pre-survey data was used to measure current knowledge of and attitudes toward assistive technology. Starred items reflect negatively worded items or items where a negative response was desirable. For purposes of analysis and to simplify comparisons, all negatively worded items were recoded to reflect agreement level. However, actual frequencies were presented in all tables. A 25% level of disagree was set by the researcher to identify areas of concern.

There were ten items included to measure attitudes toward assistive technology and special needs students. Out of the ten attitude items, five were above a 75% agreement level. All children have the same need for praise and

disabled children strive as hard as others received the highest agreement ratings of 97% agree a little to strongly agree.

Five areas of concern were identified. The statement "disabled children are more self-confident than other children" received the lowest agreement rating. Eighty-nine percent indicated that they disagreed a little to strongly disagreed with this statement. Seventy-one percent disagreed a little to strongly disagreed with the statement "there should not be special schools for disabled children". Additionally, 47% disagreed a little to strongly disagreed that disabled children should compete with others; 36% disagreed a little to strongly disagreed that children will not be uncomfortable with disabled children; and 33% disagreed a little to strongly disagreed with the statement "most disabled children do not feel sorry for themselves".

Responses to the ten knowledge questions were generally positive. Nine of the knowledge items received agreement ratings of over 92% agreed a little to strongly agreed. Ninety-nine percent agreed a little to strongly agreed that assistive technologies could enhance the learning of disabled children. No response was low enough to identified an area of concern. However, the lowest agreement (76% agreed a little to strongly agreed) was with the statement "assistive technologies are (not) all high-tech".

Post-survey Responses

Similar to the pre-survey responses, five attitude items received agreement ratings of over 80% agreed slightly to strongly agreed. Rank order of items based on agreement ratings were almost identical when comparing post-survey frequencies to pre-survey frequencies. However, most responses received higher ratings. Significant differences will be discussed in the next section, comparisons.

All ten knowledge items received agreement ratings of over 89% agreed slightly to strongly agreed on the post-survey. Rank order items were very similar to those from the pre-survey. The most notable change was from 76% agreed slightly to strongly agreed on the pre-survey to 90% on the post-survey that assistive technologies are not al high-tech.

Comparisons

Overall attitude and knowledge scores for both pre and post-surveys were computed. Negative items were recoded and then a sum of responses to the ten items in each category was computed. This provided an overall attitude score and an overall knowledge score for comparison purposes. An alpha level of <.05 was used to determine significance.

The pre-survey attitude and knowledge scores were compared to detect any differences in mean scores. T-values were computed to identify any statistically significant differences. No change was detected in attitude scores, but results indicated significantly higher post-survey knowledge scores ($t=4.857$, $p<.001$).

Table 1: Change in Attitude and Knowledge, Comparison of Pre-survey and Post-survey overall scores.

		N	Mean	SD	t-value	Significance
Attitude						
	Pre	168	41.80	4.41	1.047	.296
	Post	154	42.35	4.93		
Knowledge*						
	Pre	168	49.91	4.63	4.857	<.001
	Post	154	52.56	5.15		

**Significance <.05*

Data from the pre-survey was used to examine overall attitude and knowledge based on the three independent variables diversity class (Table 2), disabled family member (Table 3), and disabled friend (Table 4). It was hypothesized that those students who had completed the diversity class and those students who had either a disabled friend or family member would have a higher overall score on attitude and knowledge. Thus, a one-tailed test of significance was used.

Students who had completed the class on diversity had a higher overall attitude score, but a lower overall knowledge score. However, no statistically significant differences were detected based on this sample.

Table 2: Comparison Of Current Attitude And Knowledge Based On Completion Of Diversity Class

		N	Mean	SD	t-value	Significance
Attitude						
	Yes	122	42.01	4.33	.904	.184
	No	45	41.31	4.66		
Knowledge						
	Yes	122	49.67	4.74	1.264	.104
	No	45	50.69	4.22		

**Significance <.05*

Attitudes of those with a disabled family member did not appear to be much different than attitudes of those without a disabled family member. As expected, overall knowledge scores were higher for those with a disabled family member. However, on neither attitude nor knowledge were the differences statistically significant.

Table 3: Comparison Of Current Attitude And Knowledge Based On Having a Disabled Family Member

		N	**Mean**	**SD**	**t-value**	**Significance**
Attitude						
	Yes	40	41.28	3.88	.868	.194
	No	128	41.97	4.56		
Knowledge						
	Yes	40	50.85	4.84	1.476	.071
	No	128	49.62	4.54		

**Significance <.05*

On both attitude and knowledge, those having a disabled friend scored higher. A statistically significant difference was detected on attitude based on having a disabled friend.

Table 4: Comparison Of Current Attitude And Knowledge Based On Having a Disabled Friend

		N	**Mean**	**SD**	**t-value**	**Significance**
Attitude*						
	Yes	39	43.03	4.48	1.911	.029
	No	128	41.53	4.21		
Knowledge						
	Yes	39	50.21	5.02	.471	.319
	No	128	49.80	4.54		

**Significance <.05*

Discussion

This study attempted to look at three areas: current attitude and knowledge, impact of mini-workshop, and assessment instruments and procedures. Discussion will be organized around these three themes concluding with a discussion of future research plans in this area.

Current Attitude and Knowledge

Data from pre-survey responses were used to determine current pre-service teachers' attitudes toward students with special needs and knowledge about assistive technology. Attitudes were very positive. It is felt that this may not be so much a factor of teacher preparation programs but relates to students' personal schooling experiences and general social attitudes. This could also be a result of the age and sex of participants. Participants in this study were predominately traditional female college students with an average age of 21.3. If there had been a larger population of older, non-traditional students and more male elementary pre-service teachers, we could have examined differences in attitudes based on age and sex.

While recognizing that attitudes are difficult to change, there were, however, some areas of concern that need to be addressed in the teacher preparation program. The participants in this study will be, for the most part,

traditional classroom teachers and not special education teachers. It was surprising to find that almost three-fourths felt that there should be special schools for students. It is difficult to determine participants reasoning and perspectives on this without further investigation.

Perhaps more troubling was the fact that over one third felt that children in a traditional classroom would be uncomfortable with a disabled child and that disabled children feel sorry for themselves. These attitudes still persist even with today's strong focus on acceptance of diversity.

We had expected that students who had already taken the required class on diversity would have a more positive attitude toward disabled children and would have more knowledge of IDEA and assistive technology. This did not prove to be the case with this sample. The content of this course has changed with the emphasis on diversity and perhaps other issues have replaced the previous inclusion of topics related to special needs populations.

Analysis of the fall semester data had indicated differences in attitude based on having a disabled family member. This difference was not detected with the full sample. In both semesters, approximately the same percentage of participants indicated that they had a disabled family member, so this probably did not account for the change. Future research will be needed in this area including identification of the relationship of the disabled family member to explore this area in more detail.

Knowledge responses were also surprisingly positive. Students appeared to have at least an awareness of assistive technology. However, it must be cautioned that this positive response could be misleading. As the survey was self-report, students may have been marking what they felt was the expected response and therefor responses are not representative of actual knowledge.

Impact of Mini-workshop

Because of time restraints and an already overloaded curriculum, only one class period could be devoted to the presentation of assistive technologies. This short, one-time exposure was not enough to make a difference in attitudes. This was expected as attitudes tend to be firmly entrenched and difficult to change even with multiple exposures.

The mini-workshop was effective in changing knowledge. However, there are several variables at work here. It is not possible at this time to determine if this change was a factor of the technologies displayed or of the instructor. Participants were exposed to and had the opportunity to handle a variety of "toys". It is possible that this actual hands-on approach was the largest contributor to the changes in knowledge detected. A team of special education instructors presented all of the mini-workshops. How much of the change was a factor of the specialization and/or personality of the presenters needs to be examined in future research.

Instruments and Procedures

While the instrument did show to be valid and reliable, changes should be made to improve both reliability and usability. The number of items needs to be increased to improve reliability. In addition, though the original survey adapted for use in this study included negatively worded items it is felt that these items adversely affected both student responses and reliability of the instrument and should be revised prior to future use.

Future Directions

This preliminary study supports the need for the inclusion of assistive technology in the preparation of teachers. Our efforts in investigating the best way to provide this content will continue.

First, the instrument will be revised based on the results of this study. Negatively worded items will be replaced with positive statements. Attitudes will continue to be part of the pre-survey but will be eliminated from the post survey as it is difficult to impact a change on attitudes. The number of knowledge items will be increased and reworded to more closely reflect the content of the mini-workshop. The format of the knowledge items will be revised from a Likert response set to a multiple choice format that supports the overall expected competencies related to assistive technologies.

Second, the workshop be varied. A quasi-experimental design will be used to examine factors impacting change on knowledge. Experimental groups will be used to examine the impact of both the hands-on use of the technologies and the instructors. In addition, the creation of software for self-study of assistive technology is being explored.

While this preliminary study was not without limitations, it proved useful on several levels. Both individual course planning and program planning will benefit from the results of this study. The technology for teachers class and the required diversity class will be reviewed for content and the addition of assistive technology components that prepare teachers for their role in adapting the regular classroom for special needs children. Within programs, emphasis on the integration of technology, including assistive technology, across the teacher preparation program will increase.

This study was successful in building collaboration between special education and technology programs. This sets the stage for planning and funding of technology needs within the college and established a framework for

further collaborative research between these two programs. It also serves as a model for technology collaboration with other programs, departments, and colleges strengthening the technology integration across programs that is essential for the preparation of technology literate teachers.

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Mentoring for Technology Success

Marilyn K. May
Kansas State University

Abstract

Educators today are under tremendous pressure to make use of the latest in technology while continuing to provide quality educational experiences for students. Quality staff development is essential and costly, especially in rural areas. This study looked at the use of mentoring as a positive strategy for building teacher confidence in technology application skills. The study emerged as a grant to direct funds into rural schools and was specifically targeted for educational improvement through technology implementation. Qualitative and quantitative data indicated that mentoring was a positive influence on teacher technology confidence, technology integration, school climate, and staff development effectiveness.

Technology Manpower Needs and Teacher Technology Training

Career opportunities of today suggest that of the approximately 600,000 job openings currently advertised 450,000, are related to technology and knowledge of computer applications. Using technology as a tool to improve teaching and learning is a critical need in schools, but crucial to being employed in the future is knowing how to use advanced technology in a useful way (Dennis, 1998). In an Office of Technology Assessment (OTA) study of the use of technology in education, lack of training and limited knowledge about computers were the most commonly cited reasons for non-use of computers (1995). Recent studies continue to report that properly trained teachers make the difference between success or failure of technology integration efforts (Siegel, 1995). For technology based learning to be effective, teachers must select materials that help meet carefully defined instructional objectives and integrate them into learning experiences. It is time to acknowledge the vital role that teachers play in the successful use of technology for learning with support (Mellon, 1999). The 10-year ACOT project (Apple Classrooms of Tomorrow, Saltpeter, 1998) recommended that 30 percent of available technology resources be dedicated to providing ongoing staff development. A Time Magazine report claims that schools spent about $88 this year per student on computer equipment, but only $6 per student on computer training for teachers. Although 80 percent of schools have Internet access only 20 percent of teachers polled in this survey felt prepared to use technology in their classes (Nellen, 1999). A 1999 study by Market Data Retrieval (MDR) found that 61 percent of the teachers surveyed felt either "not at all prepared" or only "some what prepared" to effectively use new technology (Mckenzie, 2000

Professional Development

Statham and Torell (1996) have identified professional development as an essential condition necessary to maximize student achievement. Teachers are the keys to success, and training the teachers is essential. They state: "A commitment to technology integration includes a commitment to teacher training." The success or failure of technology is more dependent on human and contextual factors than on hardware or software (Valdez, et.al. 1999). Based on survey data Becker was able to determine that certain variables had 'important independent relationships to teachers use and valuation outcomes' (Becker, 1999). Significant factors were: quality connectivity, computer expertise, teacher pedagogical beliefs and practices, and adequate professional development (Becker, 1999). Research indicates that most school districts spend less than a quarter of their computer budgets on training (Bruder, 1993). Too often faculty professional development features one-shot workshops with limited support and follow-up for integration purposes (Hargreaves & Fullan, 1992). Joyce and Showers (1995) have argued that teacher development should be innovation-related, continuous over several sessions and involve a variety of formal and informal training sessions to meet the needs of the teacher. Their model emphasizes the need for the learner(teacher) to be shown how the application works, be provided an opportunity to practice with the application, then receive follow-up support to allow for further practice and related critical feedback

Recently staff developers spotlighted critical issues facing schools and identified mentoring programs as useful in teacher improvement (Ganser, 2000). Technology changes so fast, some teachers may not know how to keep up (Bray,1999). It would be most valuable to provide both time and opportunities for on the job professional development. On activities using technology applications of skill in the work world, students of teachers with more that ten hours of training significantly outperformed students whose teachers had five or fewer hours of training

(Becker, 1999). The use of on-sight teams or mentor groups can provide valuable guidance and increase the effectiveness of staff development time. (Dwyer, 1998).

Rural Needs

Many rural educators face these changes with the added challenge of geographic isolation. The unique needs of rural education have been recognized for generations (Leo-Nyquist & Theobald, 1997). When the education system was first established in the United States, technological improvements in printing and distribution made textbooks and educational information available to people living in rural areas. Yankee peddlers, in fact, influenced the content of textbooks by communicating to the printers the specific educational needs of rural America, (Smith, 1993). Distance education was first developed for use by farmers. Courses on repairing wagon wheels were offered to farmers who couldn't leave their fields. (Thomas, 1999). Beacham & Kester, (1994) identified telecommunications programs as useful to enhance professional growth in rural areas highlighting electronic mentoring as a strategy for bridging some of the challenges of rural isolation. Today advanced technology is able to provide rural communities with access to increased educational opportunities and information vital to quality education (Dennis, 1997).

Ferre and Associates (1988) and Kennedy and Barker (1986) identify financial and funding issues as the most critical issues faced by small rural school districts. Since nearly a quarter of the money for educational technology comes from state revenues, funding has been identified as a significant problem for a large segment of the country's educational community. Rural districts cannot compete with urban schools in the area of funding simply because of low enrollments. Corporations seek to fund programs that impact the largest numbers of students. In competing for grant dollars, rural schools are at a disadvantage because each staff member, from administration to faculty, is having to wear two or three "hats" (duty assignments) and do not have the time or experience to write successful grants (Dennis, 1997). So funding is difficult to obtain, technology is expensive and staff development effectiveness is essential.

Mentoring

The 10-year ACOT project (Apple Classrooms of Tomorrow, Saltpeter, 1998) recommended that 30 percent of available technology resources be dedicated to providing ongoing staff development. Teachers can improve their teaching practices by engaging in frequent and planned collaborative activities with other teachers. Such activities can include mentoring (Becker, 1999). Dwyer (1998) explores the theory and practice of mentoring. He argues that on –the-job mentoring has the potential to facilitate critical insight into the changing nature of teachers' work and to transform school cultures. Nellen reported that teachers participating in mentoring activities became confident enough about using technology to train new teachers, with a success rate of 100 percent (Nellen, 1999). Mentoring allows the learner's needs to define the experience rather than following a more linear, tutorial model of instruction (Nellen & Sweeny, 2000).

Similar research indicates that teacher mentoring can assist faculty members and new teachers with ongoing support and provides technology integration instruction that characterizes effective staff development (Mac Arthur et. al., 1993: Sprague et al., 1998). Anecdotal evidence from a range of mentoring projects is showing that through mentoring more significant learning occurs; a safer environment for risk-taking is developed and learning speeds up.

Mentors benefit from an increased feeling of self-worth and mentees from increased self-confidence. Adler and Harveil (1996) identified several benefits of mentoring programs that included; enhanced recognition of the value of staff development and teaming to make effective program changes and improved self-confidence in the receipt of support and encouragement. Receiving regular, honest and constructive feedback and being part of a professional network is mutually beneficial. Mentoring is seen as job-embedded, ongoing professional development which facilitates long-term change and transforms workplaces (Dwyer, 1998).

Curriculum Change

There is great deal of literature in the field on curriculum. Yet there is little empirical evidence that focuses upon attempts at curriculum change, where school districts, schools, or particular teachers are the unit of analysis (Lewis, 1998). Technology implementation requires a well-designed systemic plan, multiyear funding, and extensive professional development. Teachers, through their Internet connections, have access to resources that only a few years ago would have been impossible even for university researchers. Ninety percent of all teachers participating in Beckers research survey (with and without internet connectivity) ranked internet resources as either valuable or essential, demonstrating that teachers see the internet as a significant resource (Becker, 1999). With this

type of teacher use, sufficient staff development, and mentoring support, the integration of technology could be a supportive tool to enhance curriculum and the learning environment.

In the Mills study findings supported the position that teachers' concerns and perceptions of technology influenced the way in which they implement technology (Mills, 1999). The Lecompte, Millroy and Preissle study (1992) cited three common themes among teachers as they learned technology in the context of educational practice; 1) changes in teaching practice, 2) changes in preparation and 3) increased self-confidence with technology use. It is crucial therefore to integrate technology, pedagogy and application into competent staff development programs that demonstrate effective support for change (Moore, et. al., 1999).

Collins (1991) describes how these new teaching/learning environments differ from those of the past by citing trends identified from observations of schools that have begun using technology. The shift from lecture based, whole group instruction to coaching student-directed team-work that incorporates technology is a major change for the classroom teacher (Roblyer & Edwards, 2000). Well-developed curriculum can be the directional force that organizes and promotes technology implementation (Valdez, et.al.1999). Teachers in their critical roles as "gatekeepers" for change within their own classrooms and schools are central figures in curriculum development and change.(Leo-Nyquist, & Theobald, 1997).

Methodology

This action research study made comparisons between a traditional format of technology staff development to an onsite team-mentoring format. The traditional format of staff development incorporated two 2- day sessions of hands-on group technology instruction at the service center facility. The mentoring format used an onsite mentoring activity that included development of integrated classroom projects with onsite mentoring for collaborative support. Participation in the study was voluntary and school sites were allowed to send one team. Teams were self-selected and four schools participated. None of those participating in the mentoring project reported previously integrating technology into classroom curriculum. In each team, the member who felt most comfortable with technology skills was designated as mentor. All four schools were located within a 100 mile radius of the service center facility, located in communities with a similar agri-related economy, and classified 1-A (rural). Grant funding was budgeted to include upgrading of available hardware and software to support the individual projects designed by the teams. Funding also included stipends for extra planning and student contact hours.

Data collection was based on Profiler scores, observations, interviews and anecdotal information collected by the technology facilitator. The Profiler is a standardized online survey, developed by South Central Regional Technology in Education Consortium (SCRTEC) (http:///profiler.scrtec.org/profiler/), which includes 30 questions that assess personal confidence in technology skill and application. The survey was taken by teachers and students participating in the study as a pre and post assessment for each activity. SCRTEC is one of six Regional Technology in Education Consortia funded by the U.S. Dept. of Education, whose goal is to help teachers and other educators create, share, or find solutions to problems encountered when integrating technology into education.

Treatment

Using PowerPoint or Hyperstudio, students created presentations based on personal history. After initial instruction concerning the content of the social studies project and demonstrations of software and digital camera application, students created an outline of personal events and information that they wished to include in their presentation. Student mentoring teams then used the digital camera to collect pictures. The pictures were used as information focal points of the presentation. Students worked on formatting skills and added text to complete the history. Issues of vocabulary and editing, as well as the creative aspects of presentation development, were all part of the integrated project. Presentations were shared in a variety of ways including peer review, printed hardcopy and student conferencing. The presentations were used as examples of authentic assessment of student technology skill and social studies goals of development of personal identity, culture and community identity. Three school sites participated in teacher and student mentoring activities. Due to complications with teacher re-assignment one of the four schools did not participate in the mentoring activities.

Results

Concluding data indicated that all teachers and students completing the mentoring activities increased on profiler scores indicating that self-reported confidence of technology skills ability increased. In comparing teacher mentoring team scores before and after each type of activity (traditional staff development and mentoring activity) data show that teacher scores improved 21.33 percent more from the mentoring activity than from the more traditional staff development (Figure 1.1 & 1.3). This is three times the gain of 7.78 percent made after traditional

staff development. While traditional staff development does provide positive opportunity for teacher improvement, the addition of a mentoring program appears to greatly enhance the effectiveness of technology integration training. When comparing groups of students, those participating in mentoring activities scored over 11 percent higher than those involved with technology projects without mentoring partners (Figure 1.1 & 1.4).

1.1 Student Perception of Comfort With Technology

School site	1	2	3	4
Class A Mentor (group 1)	5.93	11.74	8.19	18.14
Class B Mentored (group 2)	15.37	6.89	7.27	18.14
Total Avg. Increase	10.65	9.32	7.73	18.14

(School sit #3 completed the technology project without mentoring)

1.2 Teacher Perception of Comfort with Technology

School site	1		2		3		4	
Teacher 1=mentee 2=mentor	1	2	1	2	1	2	1	2
Pretest	16.67	X	4.44	22.22	22.22	51.11	42.22	24.44
Staff development	20.00	32.22	57.77	31.00	25.56	60 .00	60.00	30.00
Posttest	74.44	48.89	75.55	55.56	X	X	1.11	57.78
Total Avg. Increase	57.77	16.67	21.11	33.34	3.34	17.78	38.89	33.34

(Note: The X indicates that there was no profiler score and in both cases also indicates that the teacher was not involved with the project during the designated time of evaluation.)
School site #3 did not participate in mentoring during the technology project.

1.3 Profiler Average Teacher Change

After Staff Development	8.46%
After Mentoring Activity	29.21%

1.4 Profiler Average Student Change

Without mentoring activity	7.73%
Completing mentoring activity	18.75%

Conclusion

Final evaluation interviews indicated that teachers and students felt the project mutually beneficial. Having a team member or mentor close by for support helped to promote confidence when presenting content and having students work with technology. Teachers also believed that having a colleague/mentor for collaboration increased their ability to work through a variety of technical problems. Students demonstrated greater interest in content and were more involved in reflective evaluation to improve their work. Teachers were excited by the positive responses of their students and the increased motivation they observed. The key goal of improving student performance was realized through integration of a variety of technology tools. This success provided strong encouragement for teachers to look for other opportunities to integrate technology.

Research project results mirrored those of the Nellen study (1999), with 100 percent of teachers participating in the mentoring activity. Teachers indicated that they felt the experience so valuable they intended to continue the mentoring format during the next year by instigating new technology mentoring projects. Comments made by teachers during exit interviews provided anecdotal evidence of confidence. One teacher said, "I never thought that I could learn to use technology like this. Now we already have plans for another mentoring project next year and my students are asking if they can do other projects with the computers." Another teacher enthusiastically remarked, "I saw two other project ideas that I'm going to integrate into our standard curriculum and I'm helping

another teacher make plans for a project for next year." Comments such as these document the increase in teacher confidence integrating technology into curriculum.

The use of mentoring adds a positive support for technology integration in the classroom. It's application is inexpensive, enhances traditional staff development and promotes positive staff team-building. The use of mentoring demonstrated effectiveness with both teacher and student teams. It was evident from observations and interviews that that mentoring projects between classes increased student interactivity and promoted positive school climate. The ability of mentoring teams to discuss, reflect and support each other encouraged risk-taking and self-improvement.

Additional study in the area of mentoring to enhance technology integration would be beneficial. To gain further statistical analysis of mentoring application it would be valuable to design research that would control for external variables such as grade level and project variation. The establishment of mentoring teams and mentoring training within a rural district would increase the effectiveness of teachers as resources and encourage growth and development. Mentoring encourages a positive teamwork effort to promotes educational improvement.

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Expanding a Model for Affective Development: Implications for an Activity Component

Nancye E. McCrary
University of Kentucky

Abstract

One useful framework for understanding and articulating instructional design to change biased beliefs is the Martin and Reigeluth model for affective development, appearing in Volume II of Reigeluth's Instructional-Design Theories and Models *(1999). Using this recently developed framework to examine an instructional program aimed at affecting biased beliefs suggested that the addition of activity components and the language of activity theory may have potential to extend instructional theory on affective learning. Consideration of action as both internal and external enhances the model in a way that facilitates design and evaluation of instruction to affect biased beliefs about difference. This paper examines some of the implications of including the concept of activity in the Martin and Reigeluth model for affective development.*

Introduction

While facilitating affective change has long been an issue in efforts to impact human performance (Simonson, 1995), it has most often played a rather cursory role in the development of instructional systems (e.g., Martin & Reigeluth, 1999; Kamradt & Kamradt, 1999). Moreover, when affect is addressed in the design of learning and performance systems it is often done so as an aside to performance outcomes and is fragmented as a separate, less significant domain. For example, the Dick & Carey (1996) model of systematic design addresses learner' attitudes as represented by behaviors that can be modeled and reinforced relative to intended performance outcomes. This model relies on attention, relevance, confidence, and satisfaction as related to performance goals. Such an approach tends to fragment internal and external processes and may serve traditional practice while actually constraining design. Until recently few alternative strategies for affecting attitudes existed in the field of instructional systems design (ISD). Whether this is the result of inadequate paradigms, a quest for certainty (e.g., Dewey, 1929), or, as Simonson (1995) suggests, the lack of a direct causal relationship between affect and achievement, is of less concern here than examining the potential of extending a conceptual model to guide the design of instruction aimed at affective change.

During an extensive search for instructional theory to guide the development of an instructional narrative simulation, the Martin & Reigeluth conceptual model emerged in ISD literature, offering a helpful tool for deeper thinking about affective instruction. An analysis of the instructional simulation, relative to this model, revealed, as Martin and Reigeluth indicate, that their model is incomplete (Reigeluth, 1999). This paper presents an analysis of an instructional multimedia program using the Martin and Reigeluth conceptual model. Additionally, it attempts to initiate consideration of certain aspects of activity theory as a means to enhance the model and advance development of instructional theory on affective learning.

Background for Analysis

The Martin and Reigeluth conceptual model for affective development is used here to examine a web-based multimedia instructional program aimed at changing biased beliefs about difference in sexual orientation. Jeff's Story was initially designed as a paper and pencil narrative simulation using true story narrative to situate the learner as a character in an unfolding story. It was conceived as an instructional prototype to address contemporary social problems of bias and discrimination based on a range of human differences, including racism, sexism, cultural discrimination, and homophobia. Bias about differences in sexual orientation became an initial focus because it continues to be acceptable and openly expressed in contemporary American society (e.g., Rhoades, 1994; Tierney, 1997). Developing a theoretical framework for such an innovative and controversial design necessitated reaching beyond the foundation of narrative theory (e.g., Britton & Pellegrini, 1990; Bruner, 1986, 1996; Cole, 1997; Fisher, 1995; Howard, 1991; Polkinghorne, 1988; Sarbin, 1986) to include theory on situated cognition, anchored instruction, and case study (e.g., Anderson, Reder, & Simon, 1996; Bliss & Mazur, 1996; Brown, Collins, & Duguid, 1989; Cognition and Technology Group; 1990; Lave & Wenger, 1991; Mazur & Bliss, 1995; Young, 1993) culture study and critical social theory (e.g., Appiah & Gutmann, 1996; Ayers, et al., 1998; hooks, 1994; Matsuda, et al., 1993; Merry, 1990; Peshkin, 1991; Rhoades, 1994; Tierney, 1997), moral education (e.g., Kohlberg, 1971; Petrovic, 1999; Vitz, 1990), and perception and aesthetics (e.g., Dewey, 1934 ; Eisner, 1994 ; Greene, 1995). These

rich theoretical perspectives were combined with new research findings on issues such as teaching tolerance with stories and arguments (Colesante & Biggs, 1999), reactions to racist hate crimes (Craig, 1999), and anti-gay behavior (Franklin, 2000). While all of this provided important foundation for continued development of the instructional program, there was relatively little on which to rely in ISD until Charles Reigeluth published volume II of Instructional-Design Theories and Models in 1999. The conceptual model developed by Martin and Reigeluth for this volume, along with subsequent chapters dealing with topics ranging from attitude development to character and spiritual development (Kamradt & Kamradt, 1999; Lickona, 1999; Moore, 1999) offered opportunity to examine Jeff's Story through an ISD lens.

Rationale for Consideration of Activity Theory

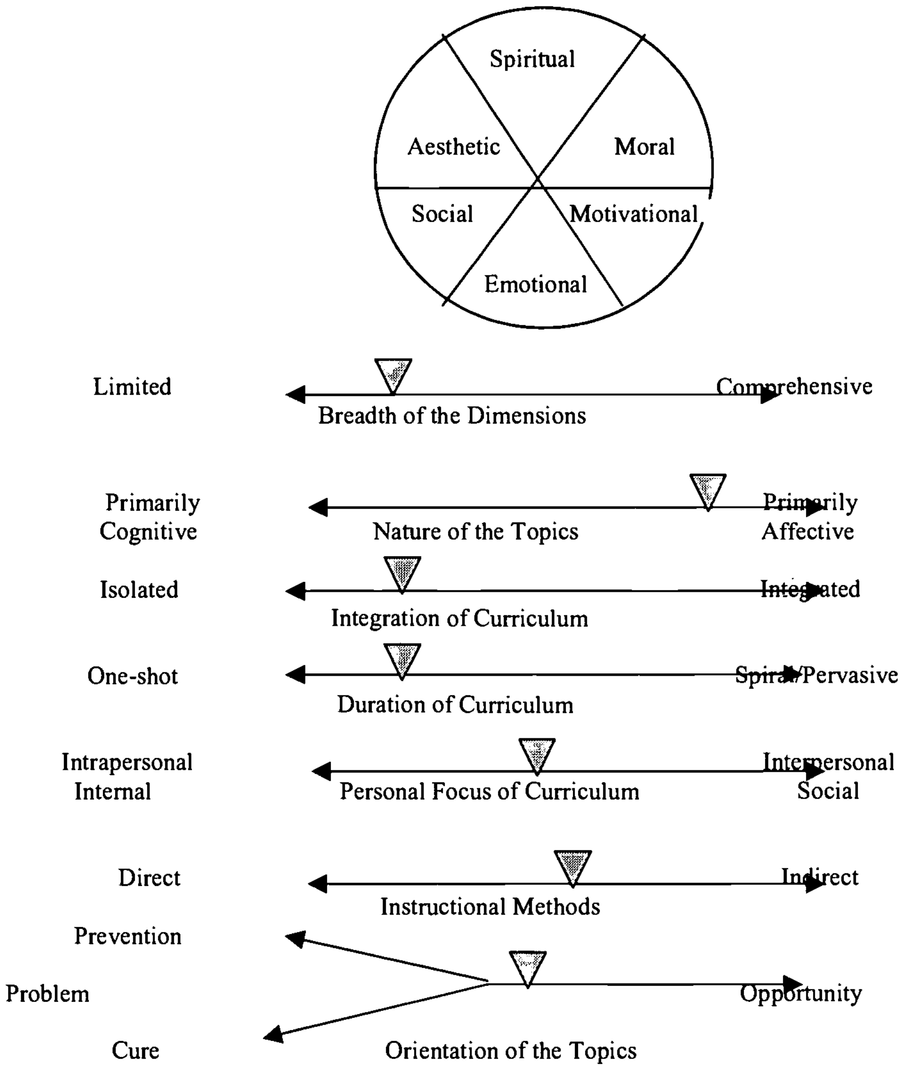
The Martin and Reigeluth model includes six dimensions of affective development and three identified components for each dimension. The dimensions are (1) emotional, (2) moral, (3) social, (4) spiritual, (5) aesthetic, and (6) motivational. The components of each dimension include, (a) knowledge, (b) skills, and (c) attitudes, as well as a fourth component labeled *other* to highlight that the model is incomplete. As such, it invites further development and encourages research and theory on affective learning in ISD. For example, according to Martin and Reigeluth, emotional development can be viewed as ability to recognize, express, and, as appropriate, control one's feelings, emphasizing understanding and managing feelings as emotional development. Yet, when applied to the design and evaluation of one instructional narrative simulation to change biased beliefs this aspect of the model lacks the means to articulate mediation of internal and external emotional activity. Designing instruction aimed at affective learning may require tools that ignite internal activity in ways that generate reflective responses not readily manifest in external form. Assessing the extent of actual change in biased attitudes about difference highlights the need to account for potentiality, intent, and generative change. Activity theory makes it possible to explain such affective changes without reducing complex processes to measures of behavior (Wertsch, 1998). It offers concepts for describing human activity and includes the central notion of mediation (e.g., Nardi, 1997; Wertsch, 1998; Zinchenko, 1997) that can be extended to instructional products. Activity theory is also concerned with setting or context in a manner that facilitates consideration of social construction of meaning, which is so crucial to design for affective learning. In these ways the language of activity theory assists in broadening the scope of instructional design aimed at affective outcomes.

Since activity theory is highly complex and offers no concrete methodology or procedural guidelines, it is important to keep in mind that it can confound design efforts, as well as extend design considerations. The challenge here is to incorporate several useful concepts of activity theory without losing sight of the focus on design of instructional products for affective learning. Therefore, this analysis is limited to the use of a few key concepts from activity theory, including 1) activity as internal and external, 2) tools as mediators of human thought, 3) thought as potential for behavior, and 4) intent as central to affective change.

Application Model

Martin and Reigeluth provide an application model based on the conceptual model for affective development. Locating Jeff's Story in this application model provides the groundwork for further analysis (Figure 1). For example, Jeff's Story is an instructional response to numerous hate crimes in the United States and, as such, is designed to be both preventive, as well as curative. Perhaps the most ambitious goal of this instructional program is the opportunity it creates for users to begin a process of embracing diversity in a country with rapidly growing ethnic populations and major shifts in majority status. Jeff's Story is designed as an isolated instructional event for adults, yet, because of the breadth of resources that users may access throughout the exercise, it has structural potential to be interdisciplinary. It is a "one-shot" experience although an important goal of the program is to ignite generative reflection and continued dialogue and therefore, can also be considered a "spiraling" learning experience. For instance, if users take away from the experience an understanding that beliefs are not always based on factual information, then the potential exists for reconsideration of a range of beliefs about difference. An important component, as evidenced in user testing (McCrary & Mazur, 1999), is a group discussion that follows the instructional event, offering opportunity for learners to express personal understandings in public conversation. In this way the program is both internal and social (intrapersonal and interpersonal) to the extent users contribute fully and honestly to the discussion. The instructional methods employed in the narrative simulation are direct in the sense that users become a character in an unfolding story that includes dilemmas to which they are asked to respond. The methods can also be considered indirect in efforts to engender empathy and reflection.

Figure 1. Adaptation of the Martin &Reigeluth Application Model as Applied to Jeff's Story, positioned in the Model with a Triangle on each Continuum.



The Conceptual Model

The design of Jeff's Story, as it incorporates concepts of activity, reintegrates the six dimensions of affective development while primarily focusing on social and emotional change. For example, it includes aesthetic mediators in the form of original music and images in an effort to enhance emotional responses, as well as to create interest and motivation. Jeff's Story includes a moral dimension by presenting possible conflicts in an effort to create cognitive dissonance (e.g., Piaget, 1970) between stereotypical beliefs and ethical standards. Affective design features are supported by didactic information in the form of historical accounts, news articles, and hyperlinks to websites that provide additional information.

Analysis

In order to provide a detailed analysis of Jeff's Story as related to the Martin and Reigeluth model it is helpful to examine each dimension of the model separately as it is represented in the instructional program. Following Table 1, which shows the original conceptual model, each dimension is discussed briefly and represented in Tables 2-7 as

adapted to Jeff's Story in the language of activity theory. Each dimension, as shown in Tables 2-7, revolves around a major instructional goal or enhanced ability (e.g., Zinchenko, 1997), including empathy, reflection, imagination, aspiration, prosocial values, and democratic principles. It is important to keep in mind that Martin and Reigeluth focus their model on school-based curricula, while Jeff's Story is designed for adults who are parents or professionals working with adolescents. Tables 2-7 illustrate an examination of the instructional program relative to a) design components, b) mediating elements, and c) evaluation data for each affective dimension. While knowledge, skills, and attitudes are represented as distinct learning activities to compliment the structure of the Martin & Reigeluth model, it is important to remember that, from an activity perspective, these domains may be inseparable.

Table 1. Martin and Reigeluth Conceptual Model for Affective Development

	COMPONENTS OF INSTRUCTIONAL VALUE			
DIMENSIONS	**Knowledge**	**Skills**	**Attitudes**	**?**
Emotional Development	Knowing others experience the same emotions you do, such as joy and anger.	Recognizing emotions and controlling one's own emotions.	I want to be happy. I don't like to be angry.	?
Moral Development	Understanding moral and ethical rules of the culture, such as caring, justice, and equality.	Moral reasoning and problem-solving skills in the realm of morals.	I want to be honest and I am in favor of having ethical standards.	?
Social Development	Understanding group dynamics and democratic ideals.	Social skills, including interpersonal communication skills.	I want to interact positively with others and am opposed to resolving disagreements by fighting.	?
Spiritual Development	Knowledge of religious precepts about the spiritual world, such as the nature of the soul.	Skills for getting in touch with your inner self. Ability to love others selflessly.	I want a spiritual life and am in favor of prayer to build a relationship with God.	?
Aesthetic Development	Understanding the subjective nature of aesthetics, such as the relationship between one's values and one's judgments.	Skills for assessing aesthetic qualities and generating aesthetic creations.	I want to surround myself with things of beauty.	?
Motivational Development	Understanding internal and external rewards for sustained activity, such as joy and sense of accomplishment.	Skills for developing one's interests, both immediate and life-long.	I want a career that I enjoy.	?

Emotional Development as a Dimension of Affective Development

Emotional development can be viewed as ability to recognize, express, and, as appropriate, control one's feelings. Individuals can move through feeling states without associating meaning or understanding to those emotions. Martin and Reigeluth emphasize understanding and managing feelings as emotional development. True story narrative simulation, focused on emotionally difficult topics, provides experience and practice in identifying feelings regarding dilemmas in the story.

Table 2. Analysis of the Instructional Program Relative to Emotional Dimension.

Empathy	Affective Learning Activities Relative to Emotional Dimension		
	Knowledge Activity	**Skill Activity**	**Attitude Activity**
Conceptual Model for Affective Development (Martin & Reigeluth)	Knowing others experience the same emotions you do, such as joy and anger.	Recognizing emotions and controlling one's own emotions.	I want to be happy. I don't like to be angry.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Recognizing inconsistencies between long held beliefs and new information.	Simulated problem solving as a character in an unfolding story.	Desire to understand why I feel the ways I do about homosexuality.
Design Components	Back Page News. Historical Accounts. News Articles. Links to Advocacy Groups.	Unfolding Narrative. Questions. Response Choices. Group Discussion.	Perspectives. Concerns. Voices.
Mediating Elements	User controlled navigation. Access to a variety of information presented formally, informally, and as personal statements.	Story Veracity. Fidelity to True Story. Storied Dilemmas.	Images. Music. Authentic Statements. Color.
Evaluation Data	Computer Tracking Data. Program Evaluation. Video Data. Individual Interview Data.	Computer Tracking Data. Program Evaluation. Observation of group discussion.	Retrospective Program Evaluation Questions. Follow-up Evaluation. Analysis of individual interview data.

Moral Development as a Dimension of Affective Development

Although moral development has been addressed in many ways, Martin and Reigeluth describe it as building codes of behavior and rationales for following those codes. They offer as an example having positive attitudes about empathy as compared to understanding or experiencing feelings of empathy, which are components of emotional development. This area of affective development is concerned with what is considered right and wrong behavior or action in relation to issues like social justice. Although Jeff's Story attempts to avoid prescriptive codes of behavior, it offers opportunity for moral development through a process of decision making in a simulated environment. Jeff's Story also provides opportunities to identify biases, discuss those biases with others, and express rationales for personal views on homosexuality. The sequencing of the storied narrative follows a pattern of describing particular dilemmas followed by questions and response choices. Each response choice is linked to a discussion of possible consequences as a result of that choice. This practice of problem solving is designed to stimulate thinking that will assist users in identifying their own beliefs relative to each situated problem. This unfolding process itself has the potential to create cognitive dissonance, which in turn has the potential to stimulate reflection. Such reflection may be a necessary internal activity for generating serious reconsideration of long held beliefs. In terms of moral development, as defined by Martin and Reigeluth, Jeff's Story is designed to stimulate examination of beliefs about homosexuality by juxtaposing socially constructed beliefs, one's own situated code of ethics or morality, and disturbing events in the instructional narrative.

Table 3. Analysis of the Instructional Program Relative to Moral Dimension.

Prosocial Values	**Affective Learning Activities Relative to Moral Dimension**		
	Knowledge Activity	**Skill Activity**	**Attitude Activity**
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding moral and ethical rules of the culture, such as caring, justice, and equality.	Moral reasoning and problem-solving skills in the realm of morals.	I want to be honest and I am in favor of having ethical standards.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding that biased beliefs are based (in part) on a social norm of heterosexuality.	Using independent thinking to resolve conflict between moral stance on homosexuality and moral beliefs about respect for others.	Desire to treat all people according to ethical standards.
Design Components	Historical Accounts News Articles Statistical Information	Strategic Questions Response Choices Response Choice Discussions	True Story Narrative Authentic Personal Statements
Mediating Elements	Juxtaposition of didactic information on particular viewpoints of homosexuality with true story narrative.	Situating the user as a character in an unfolding story.	Disturbing true story problems and outcomes.
Evaluation Data	Computer Tracking Data Program Evaluation Individual Interview Data	Observation of group discussion, comparison of tracking data with interview transcripts relative to what users say about navigation through resources in the program.	Observation of Group Discussion Retrospective Program Evaluation Questions Individual Interview Data

Social Development as a Dimension of Affective Development

Social development relates to having and maintaining positive relationships with others. It has to do with valuing relationships and distinguishing positive ways to promote such interactions. Jeff's Story is perhaps focused more on social development than any of the other dimensions. It offers experience and information designed to promote group discussion in which users are expected to engage in dialogue with others to share perspectives on homosexuality and discrimination.

Table 4. Analysis of the Instructional Program Relative to Social Dimension.

Democratic Principles	**Affective Learning Activities Relative to Social Dimension**		
	Knowledge Activity	**Skill Activity**	**Attitude Activity**
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding group dynamics and democratic ideals.	Social skills, including interpersonal communication skills.	I want to interact positively with others and am opposed to resolving disagreements by fighting.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Hearing and understanding the views of others on prevention of adolescent suicide and homosexuality.	Identifying and articulating one's own perspectives on homosexuality.	Desire to maintain positive interactions with all others even when they are different or disagree with my views.
Design Components	Historical Accounts. Authentic Statements. News Articles. Back Page News. Links to Resources.	Strategic Questions. Response Choice Discussions. Group Discussion.	Unfolding Storied Dilemmas. Authentic Statements. Disturbing Outcome.

Mediating Elements	Juxtaposition of the effects of discrimination with negative beliefs about homosexuality.	Identifying and articulating one's own beliefs regarding same-sex orientation.	Storied consequences of discrimination based on sexual orientation. Original Music.
Evaluation Data	Computer Tracking Data Program Evaluation Group Discussion Data Individual Interview Data	Observation of group discussion.	Program Evaluation Follow-up Evaluation Individual Interview Data

Spiritual Development as a Dimension of Affective Development

Martin and Reigeluth view spiritual development as distinct from religion. It is concerned with awareness of the human soul or spirit and the interconnectedness of all souls. Specifically, spiritual development relates to our ability to love all people based on a concept of oneness, according to these authors. Jeff's Story is directly related to this dimension in the sense that it juxtaposes universal concerns like caring for an adolescent who is struggling with a topic that many feel is unrelated to their own circumstances. It situates the distant other in the typical American home. This strategy is designed to encourage users to imagine the homosexual other as part of the family and as spiritually connected as anyone else.

Table 5. Analysis of the Instructional Program Relative to Spiritual Dimension.

Reflection	**Affective Learning Activities Relative to Spiritual Dimension**		
	Knowledge Activity	**Skill Activity**	**Attitude Activity**
Conceptual Model for Affective Development (Martin & Reigeluth)	Knowledge of religious precepts about the spiritual world, such as the nature of the soul.	Skills for getting in touch with your inner self. Ability to love others selflessly.	I want a spiritual life and am in favor of prayer to build a relationship with God.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding that religious/spiritual beliefs are constructed through past experiences and cultural influences.	Distinguishing truth from stories held as truth or religious doctrine.	Desire to resolve conflicts between religious beliefs, personal spirituality, and new feelings arising from simulated experience as the parent of a gay adolescent.
Design Components	True Story Narrative. Historical Accounts. News Articles. Authentic Personal Statements.	Storied Dilemmas. Strategic Questions. Response Choices.	Veracity of the narrative that assists users in imagining the adolescent in the story as their own son.
Mediating Elements	Storied juxtaposition of a typical adolescent who also happens to be gay.	Making difficult decisions as a parent of the adolescent in the story.	Confronting attitudes of others and recognizing one's own through group interaction.
Evaluation Data	Computer Tracking Data. Program Evaluation. Observation. Individual Interview Data.	Computer Tracking Data. Program Evaluation. Group Observation.	Retrospective Program. Evaluation Questions. Follow-up Evaluation.

Aesthetic Development as a Dimension of Affective Development

Aesthetic development is concerned with appreciation of beauty, which includes recognition, creation, and valuing aesthetic qualities. It is a development of sensitivity to one's internal and external environments. Aesthetics include organization of space, time, and thought in ways that are pleasing, ways that are congruent, unified, balanced, and interesting. It relates to cognitive dissonance theory in the sense that human beings may naturally seek balance and consonance in their minds, as well as in their surroundings. Beauty is in the mind of the beholder by virtue of the level of aesthetic development achieved. The design of Jeff's Story employs narrative and other

aesthetic mediators as central to affective instruction. These mediators include original art, chosen for qualities that have potential to enhance and extend the storied topics, original flute music, composed specifically for each story theme, and a variety of compositional elements to engender interest and facilitate the process of making meaning of the events in the program. Since this instructional design and development project focuses on facilitating enhanced perception and stimulating reflection, concern for aesthetics is viewed as essential in mediating internal activity that may lead to new perspectives.

Table 6. Analysis of the Instructional Program Relative to Aesthetic Dimension.

Imagination	Affective Learning Activities Relative to Aesthetic Dimension		
	Knowledge Activity	**Skill Activity**	**Attitude Activity**
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding the subjective nature of aesthetics, such as the relationship between one's values and one's judgments.	Skills for assessing aesthetic qualities and generating aesthetic creations.	I want to surround myself with things of beauty.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding the subjective nature of beliefs about homosexuality and the opportunity afforded by subjectivity to imagine new ways of viewing same-sex orientation.	New appreciation of the beauty and function of human diversity, imagining positive ways to interact with homosexuals or others who are different in some way from oneself, and recreating one's own stories about same-sex orientation.	Desire to enrich and enhance one's life through interactions with those who are different from one's self and appreciate the subjective nature of diverse perspectives, as well as one's own subjectivity.
Design Components	Story Themes. Response Choices. Response Choice Discussions. Historical Accounts. Voices. Perspectives. Back Page News. Concerns.	Consonant and dissonant patterns in the narrative, imagery, and music.	True Story Narrative. Perspectives. Back Page News. Response Choice Discussions.
Mediating Elements	Images. Original music, composed to reinforce story themes. Simulated role as an actor in the in the story.	Solving problems, selecting possible responses, and reading contrasting excerpts of other's stories that inspire thinking about the subjective nature of that based on stories heard and remembered in ways that reinforce one's own beliefs and comfort.	Veracity. Fidelity. Imagery. Original music, composed to reinforce story themes. Group Interaction. Group Discussion.
Evaluation Data	Program Evaluation. Response Choices. Individual Interview Data. Group Discussion Data.	Computer Tracking Data. Program Evaluation. Individual Interview Data. Group Discussion Data.	Retrospective Program Evaluation Questions. Individual Interview Data. Group Discussion Data.

Motivational Development as a Dimension of Affective Development

Developing one's own interests is the major concern in motivational development. Preference, choice, focus, and navigation are all elements of Jeff's Story that acknowledge personal style and facilitate individual interests. While this instructional program is not specifically designed to promote motivational development it offers opportunity to identify preferences and navigate according to one's particular curiosity. Computer generated tracking data is used partially to provide insight into the motivations and interests of learners.

Table 7. Analysis of the Instructional Program Relative to Motivational Dimension.

Aspiration	Affective Learning Activities Relative to Motivational Dimension		
	Knowledge Activity	**Skill Activity**	**Attitude Activity**
Conceptual Model for Affective Development (Martin & Reigeluth)	Understanding internal and external rewards for sustained activity, such as joy and sense of accomplishment.	Skills for developing one's interests, both immediate and life-long.	I want a career that I enjoy.
Narrative Simulation to Affect Biased Beliefs about Homosexuality (Jeff's Story)	Understanding personal and social benefits of diversity.	Deconstructing one's own stories about people who are gay.	Desire to interact in positive ways with homosexuals or others who are different from one's self and feeling that such interaction will enrich one's life.
Design Components	Storied Dilemmas. Response Choices. Response Choice Discussions.	Simulated exposure to a variety of attitudes, beliefs, and information about homosexuality.	User Controlled Navigation. Historical Accounts. News Articles. Links to and Descriptions of Advocacy Groups. Concerns.
Mediating Elements	Reflection due to simulated experience with the perspectives of others.	Immediate feedback on response choices in the form of discussions of possible consequences associated with particular choices of action.	Stimulated experience in the role of a parent of the adolescent in the story.
Evaluation Data	Program Evaluation. Individual Interview Data.	Selected Response Choice Data. Retrospective Program Evaluation Questions. Individual Interview Data. Group Discussion Data.	Computer Tracking Data. Retrospective Program Evaluation. Observation of Group Interaction. Video Data of Group Discussion.

Research Implications

The integration of several key concepts from activity theory with the Martin & Reigeluth model serves research, as well as design, in developing instruction aimed at bias. For example, the conceptual model describes what learners will be able to do as a result of instructional intervention, while activity theory turns attention to the mediation of internal and external to create opportunity for new activity. Consideration of mediating internal and external activity provides opportunity for asking qualitatively different research questions that have more to do with how the process of affective change evolves. Relative to Jeff's Story, it is helpful to examine each dimension of affect (Martin & Reigeluth, 1999) through mediating processes. Aesthetic change, for example, includes 1) perception of the storied nature of beliefs, 2) imagination of what can be, 3) appreciation for the beauty of and necessity for human diversity. The questions evolve from how to promote appreciation of beauty and style (Martin & Reigeluth, p. 94)" to more specific inquiry into perception and imagination. Table 8 frames Jeff's Story relative to mediating activities of instructional goals.

Table 8. Mediating Activities for Desired Instructional Outcomes for Jeff's Story.

Dimension	Mediating Activity	Desired Instructional Outcomes
Aesthetic	Perception	of the storied nature of beliefs.
	Imagination	of what can be.
	Appreciation	for the beauty and necessity of diversity.
Social	Articulation	of biased beliefs in a group setting.
Emotional	Empathy	for the feelings and experiences of others.
	Tolerance	for the differences of others.
Spiritual	Self reflection	on the nature and origins of one's beliefs about others.
	Connectedness	to all human beings.
Motivational	Value	for diversity.
	Desire	to be tolerant.
Moral	Principles	guiding behavior towards others.
	Fairness	in relation to issues of social justice.

Summary

As apparent in both the Martin and Reigeluth model and the analysis of Jeff's Story, instructional priorities for affective outcomes, as opposed to performance or behavioral goals, may require new ways of approaching design and research. Including certain concepts of activity theory extends consideration of learning as integrated internal and external processes that are facilitated by mediating processes like perception, imagination, and reflection. This hybrid approach prioritizes mediation over information, feelings over facts, and meaning over certainty. Traditional concern for structure and sequence of instruction is transformed to artful composition of learning environments that provide opportunity and potential for new representations. Such an approach to affective learning may actually promote a broader understanding of human development, integration of interdisciplinary perspectives, and understanding design as the composition of elements in space and time to promote learning.

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Towards a Person-Centered Model of Instruction: Can an Emphasis on the Personal Enhance Instruction in Cyberspace?

Christopher T. Miller
Joan M. Mazur
University of Kentucky

Abstract

A person-centered model of instruction has been developed for use in designing instruction in virtual, web-based environments. This model, based on the work of Carl Rogers attempts to address several issues raised in the literature regarding a) the changing role of instructors and students b) the broadening of the notion of learning outcomes, c) the isolation and dissatisfaction of students in dispersed locations and d) problems with authenticity and individualization of experience. A person-centered instructional model is described and contrasted with instructionist (Dick and Carey) and constructivist (Jonassen) approaches.

Introduction

Virtual, web-based environments, while attractive in their potential to widen the scope of users' experiences for communication, collaboration, and access to resources can also create artificial and possibly depersonalizing social circumstances. A person-centered model of instruction has been developed for use in designing instruction in virtual, web-based environments. This model, based on the person-centered theory of Carl Rogers attempts to address several issues raised in the literature regarding a) the changing role of instructors and students b) the broadening of the notion of learning outcomes, c) the isolation and dissatisfaction of students in dispersed locations and d) problems with authenticity and individualization of experience. How should instructors confront these types of issues which arise in a distributed instructional network?

In this paper we posit that Rogers' work can be used to design instruction for virtual web-based environments and we offer a conceptual analysis upon which to base this claim. A person-centered instructional model is described and contrasted with instructionist (Dick and Carey) and constructivist (Duffy and Jonassen) approaches. A discussion of problems and potentials concludes the article.

Defining Virtual Environments

As with any new technology, definitions that are complementary, mutually exclusive, subsuming, and directly contradictory seem to proliferate as fast as the innovation itself. Virtual reality and its many applications are no exception. In this section we give an overview of prominent definitions and select one, to be used for purposes of analysis in this article. Virtual reality (VR) is, quite literally, an analogous reality to our own but with one significant difference--it occurs in computerized and/or networked electronic environment. Definitions of VR range from " one part computer simulation and one part consensual hallucination" (Biocca & Levy, 1995; Gibson, 1984 p.54) to a computer-created sensory experience completely immersing a participant so they believe and barely distinguish a "virtual" experience from a real one (Franchi, 1994).

Types of VR applications tend to fall into two general categories: immersion and simulated environments. VR immersion environments using specially designed hardware worn by the user can literally make the individual feel like they are in another environment in a cyberspace. In contrast, in VR simulated environments, the user experiences a particular context or situation in a much less sensory and more cognitive way, by accessing software applications on a networked hyperspace -- such as the World Wide Web. These types of WWW virtual environments have several common applications. Users can take virtual tours of on-line museums or other remote locations such as strolling around virtual parks or navigating to selected locations via a virtual map of particular areas. Another common VR simulation environment-- a chat room-- provides tools for participants to talk with people at geographically dispersed locations in real time conversations. Since simulated VR environments require less hardware and technical commitment, they have tended to flourish in educational settings.

In fact, according to Mason (1996), the many virtual classrooms and universities can be characterized by three broad categories:

1. Text based systems, including electronic mail, computer conferencing, real time chat systems, MUDs/MOOs, and other WWW applications;
2. Audio conferencing such as audiographics, and real time audio over the Internet; and

3. Videoconferencing, one-way and two-way, software driven videoconferencing and other web-based visual media.

Virtual education purportedly differs from traditional education in less obvious ways than the presentation mode. Chalmers (1997) asserts that a virtual educational space can offer increased levels of interactivity and the development of learning communities through the use of the communication tools described by Mason. One example of this increased activity level is apparent in a text-based interactive learning environment, PuebloMOO. PuebloMOO (http://www.pc.maricopa.edu/community/pueblo/) is a complex environment where the students are free to explore a world created completely in the computer, interact with other people, and make choices regarding the character they use (called an avatar) in the virtual environment. The opportunity to personalize one's role in a virtual environment could be beneficial because it allows learners to meld learning with recreation and socialization developing activities all at one time.

Virtual environments, while attractive in their potential to support a variety of users' interactions, also have the potential to create artificial and possibly depersonalizing social circumstances.

Dehumanizing Effects of Virtual Environments

Concerns associated with the dehumanizing effects of mass-produced, one-size-fits-all instruction is framed by the largely European debate of *Fordist, Neo-Fordist* and *Post-Fordist* approaches (Campion, 1995). On a continuum from maximum central control, low skill, and little learner responsibility (Fordism) to less managerial control, high skill and responsibility for learning (Post-Fordism), each position implies that control emanates from the point of instruction (or the instructor) and is not shaped through negotiations between the instructor and learner. In other words, though the debate addresses issues, which arise from the social, the underlying epistemological assumptions of the positions specifically exclude the social negotiation of learning. While this theoretical debate is less publicly articulated in the United States, it is important to note how often disgruntled distance education students report they feel alienated and dissatisfied with on-line learning (Biner, Dean, & Mellinger, 1994). Students at the so-called "remote sites" complain of a lack of co-presence with the instructors and other students. In fact, the only consistently reported benefit is "convenience." While American educators claim interaction and personalized instruction are valued (Simonson, Smaldino, Albright, & Zvacek, 2000 p. 41), reports of distance learning experiences show these goals less often achieved in actual practice. How should instructional designers use and possibly modify available theory and concepts to maximize the potential of virtual environments while confronting the personalization issues that seem to develop in a distributed network of instruction?

In search of theory-based instruction for Virtual, Web-based Environments

The introduction of new interactive technologies inevitably effects the learning context. In virtual environments, both the role of the instructor and the form of instruction will change dramatically. A central change will be less control for the instructor coupled with more opportunities for learner-selected and -controlled exploration and interaction. Indeed, unbeknownst to the instructor at any given point in time, students may be logging in and participating actively. Directive, didactic forms of instruction will need modification. Instruction that is shaped and enhanced by facilitation may be a key to accommodating increased learner control. Students will clearly need specialized guidance exploring their on-line learning opportunities and the design of instruction will need to take into account the special nature asynchronous interaction supported by web-based virtual environments. We hypothesize the notion of instructional design as primarily facilitation can be informed by the work of Carl Rogers.

When Rogers wrote Freedom to Learn (1994), he was focused on traditional schools but saw the person-centered educational approach developing its strongest roots in alternative schools and what he presciently called "universities without walls." While many instructional theories focus on the learner's achieving specific learning objectives, Rogers' instructional theory focuses on a goal of teaching the learner how to learn. It is because of this focus that Rogers felt the learner would become a freely functioning, self-enhancing, self-actualizing, creative, and dependable person.

Carl Rogers revealed that he developed his person-centered theory because we live in a constantly changing world and that people in such continually evolving contexts needed to be flexible thinkers adapting easily to change. More importantly, he claimed, the constant of change required students to learn how to learn to adapt to different types of learning required in a variety of settings for myriad purposes. Rogers boldly suggested the facilitator should encourage the learners to charge off in new directions dictated by their own interests and to unleash their sense of inquiry and exploration (Rogers & Freiberg, 1994). How can the design of instruction support such learner directed activity? What, if any, will be the outcomes of such instruction and how can evaluation take place? Will assessment

be mutual or individual? What kinds of performance are desirable? Will learner development and satisfaction lead to outcomes that will be valued personally and publicly?

The purpose of this paper is to discuss the utility of the person-centered instructional theory of Carl Rogers for designing instruction in virtual environments based on both a conceptual and a comparative analysis. The conceptual analysis focuses on outcomes ascribed to web-based learning from the literature as they can be framed by specific aspects Rogers' theory such as personal development and learners' self actualization. Next, we present a model of person-centered instruction and compare it to two prominent instructional approaches. We follow this discussion with a case example of a course, which applies aspects of the model. Finally, a discussion of problems and potentials with the model concludes the article.

A conceptual Analysis of Rogers' Person-Centered Instructional Theory

Using an Epistemological Heuristic

We posit that the foundational conceptual analysis for our investigation of the utility and robustness of Rogers' work as it may be applied to on-line, virtual learning environments must begin with a sound epistemological analysis of his theoretical perspective. In order to accomplish this goal, we employed the "structure of knowledge" approach developed by Gowin (1981). This approach is particularly appropriate because it is inquiry-based -- the analysis proceeds from central questions emanating from a learning event (in our case the event is "instruction in a web-based environment). Our central "focus questions" are "what are the epistemological elements (world view, principles, concepts) of Rogers' theory?" and "how can these be applied to instructional design in virtual environments?" Gowin's heuristic details several components of the underlying knowledge structure of a given theoretical approach such that world view, core principles and concepts are related to directly to a specific learner event and the various knowledge claims and value to the learner can be described. The results of this analysis follow.

Carl Rogers and Person-Centered Learning

Carl Rogers developed a system of non-directive psychology called client-centered therapy that allows the client, who knows what hurts, to marshal the resources of personal experiences and discover their own meanings. The client learns through such reflective experience and uses it to grow as a person. Rogers hypothesized that core concepts of client-centered psychology could be applied analogously towards a person-centered education.

Rogers theorized that a person emerging from therapy or from the best of education has experienced optimal psychological growth (Rogers & Freiberg, 1994). Specifically, the person is able to function freely -- realizing his or her potentials, striving to be self-enhancing, continuing to develop, and always seeking newness in each moment-- resulting in a self-actualized person. Maslow (1970), describes this self-actualized person as someone who has developed or is developing into the full stature of personal capability. Of importance is that learners continue to learn creatively through life rather than becoming automatons reciting the information provided to them (Patterson, 1973). Rogers himself tied self-actualization to creativity with these words: "The mainspring of creativity appears to be the same tendency which we discover so deeply as the curative force in psychotherapy - one's tendency to actualize oneself, to become one's potentialities . . . the urge to expand, extend, develop, mature - the tendency to express and activate all the same capabilities of the organism . . . " (Davis, 1992 pp. 3-4). Building on Rogers, Davis claims creativity involves developing your talents; learning to use your abilities; exploring new ideas, places, activities; and developing a sensitivity to problems of others and humankind (Davis, 1992 p. 7). In a person-centered approach the linking of self-actualization, freedom, and creativity will be required in order to design instruction, which accommodates the largely unfettered, learner-controlled choices available to a user.

Davis' (1992) elaborated the notion of creativity in terms of what he called the "4-P's": The creative person, process, product (Barron, 1988), and press (Isaksen, 1987; Mooney, 1963; Taylor, 1988). The creative person is the individual in the creative environment, moving through the process of creativity, or having created the creative product (Davis, 1992). The creative process is the steps taken to creatively solving real problems (Davis, 1992). The creative product is the outcome of the creative process. It can emphasize originality, and a sense of value (Davis, 1992). Creative press (as in pressure) is the social and psychological environment affecting any other aspect of the creative person, process, or product or all three.

While the development of self-actualized creative people, who are life-long learners, is clearly a commendable goal, how can this goal be actually achieved? Firstly, an instructor should realize self-actualization cannot be taught and the student reaches the goal of becoming a self-actualized person through his or her own individualized learning experience. Unlike didactic teaching methods, which provide knowledge to the learners, the

teacher in a person-centered environment becomes a facilitator of the learning the students conduct. Such a facilitated experience is termed "significant learning" because the individual initiates it, allowing the individual to provide personal control with the element of learning built into the whole experience (Sahakain, 1970). In this experience the learner becomes "the creative person" engaged in a creative process. There are several tasks for an instructor wishing to move into a facilitator role. The teacher should first set the mood for the environment or the creative press. There should be a sense of cooperation and trust within the group enhancing the creative experience rather than competitive attitudes which will disrupt the sense of trust and cooperation thus creating a negative creative press on the experience. Next, the teacher as facilitator becomes one of many resources of information rather than as the main source of information for the students. Most importantly though, the teacher as facilitator should be genuine and strive for awareness of personal attitudes. The teacher also needs to feel acceptance of his or her own feelings thus developing an authentic relationship with the students (Rogers, 1961).

Furthermore, the instructor needs to be self-actualized in order to foster these qualities in the students (Patterson, 1973). When Rogers and Freiberg (1994) talked to students, they found many of the same tasks required to be become a facilitator were also wanted by students. They found students want to be trusted and respected, want freedom, a place where people care, choices to make decisions, and teachers who helped them succeed (Rogers, 1961). In a person-centered educational experience not only will the learner create a creative product from the learning experience, but the learner's increased self-actualization can also be considered a creative product. As a learner becomes more self-actualized, the learner will be able to perceive reality more accurately; accept him or herself and others; understand varying views and perspectives; become more spontaneous, independent, and more creative (Davis, 1992; Maslow, 1970).

Table one that follows describes a model of person-centered design distilled from the above conceptual analysis and illustrates how creativity operates within the model. Additionally, this person-centered model is contrasted with classic instructionist and constructivist approaches.

A **Person-Centered Model of Instructional Design**

In this section we move on to our second focus question "how can Rogers' theoretical elements be incorporated into an instructional design model that will be useful in virtual, web-based environments?"

Table 1. Person-Centered Instructional Design Model to the "4-Ps" of Creativity

Person-Centered Instruction (Rogers)	**"4-Ps" of Creativity**
Learner Analysis Emphasis is on the learners' interests, personal ability, and prior knowledge of a given topic.	Creative Person Emphasis on the person.
Task Formation Task formation proceeds through an analysis of integrating students knowledge and interests around the principles of the content or discipline.	Creative Person Focus on developing tasks centered around the person
Learning Environment Selection Select a non-competitive environment that supports cooperative learning and allows the learner to take responsible control over it.	Creative Press Creating a social/psychological environment to support the person, process, and product
Develop Learning Goal Develop individual achievable objectives within the context of the learning experience based on the students' interests and abilities and contract with the instructor.	Creative Process Process of selecting a goal (creative product)
Individualized Assessment Development Work with students to develop forms of self-evaluation.	Creative Process Develop ways to test goal achievement
Reciprocal Teaching Organize the areas of interest to cover in the topic and sequence in a format to maximize the learning potential.	Creative Process Organizing the process of the experience

Person-Centered Instruction (Rogers)	"4-Ps" of Creativity
Selection of Instructional Resources Identify and select resources to enhance the learning experience and present them to the students. The teacher presents himself or herself as a resource.	Creative Process and Press Selecting resources to support the process and teacher taking role of a resource to support the social/psychological environment
Learner's Self Evaluation Learners conduct self-evaluation based on the contract of the level of personal involvement, self-initiated involvement, and pervasiveness, which shows the significance of the learning experience.	Creative Process Testing and evaluating the process and the creative product
Outcomes of Process 1. Significant Learning 2. Self-actualization 3. Creative product (The learner will show not only an accumulation of knowledge of the topic but also satisfaction in the learning, desire to master the experience, and a greater understanding of the problem, and potential resolutions)	Creative Product Learning, self-actualization, and a product emphasizing the originality of the person are created.

In table two below we provide a comparison of Rogers' person-centered elements with two design models -- the classic instructional design of Dick & Carey (1996) and constructivist design as described by Jonassen (1999).

Table 2. Comparison of Instructional Design Models

Instructionalist Design (Dick and Carey)	Constructivist Design (Jonassen)	Person-Centered Instruction (Rogers)
Needs Assessment Determine what is the optimal situation and the actual situation. Find what change is needed to fill the gap between the situations. This will identify the instructional goal.	Problem Definition Define how the problem is represented and the manipulation space.	Learner Analysis Emphasis is on the learners' interests, personal ability, and prior knowledge of a given topic.
Task Analysis Determine step by step how the students will accomplish the goals.	Determine Problem Dimensions Determine what is needed to resolve the problem.	Task Formation Task formation proceeds through an analysis of integrating students knowledge and interests around the principles of the content or discipline.
Learning Environments No focus on developing a learning environment.	Describe Learning Environment Supports Determine the cases, resources, and tools needed to provide support for the learning environment.	Learning Environment Selection Select a non-competitive environment that supports cooperative learning and allows the learner to take responsible control over it.
Performance Objectives Development Write performance objectives of what students will be able to do upon completion of the instruction.	Goals and Constraints Are Unstated Uncertainty is a plus. Offer no rules for predicting the outcome.	Develop Learning Goal Develop individual achievable objectives within the context of the learning experience based on the students' interests and abilities and contract with the instructor.
Assessment Instrument	Alternative Assessments	Individualized Assessment

Instructionalist Design (Dick and Carey)	Constructivist Design (Jonassen)	Person-Centered Instruction (Rogers)
Development Develop assessment instruments to measure task achievement.	Development Provide opportunities for flexible, creative demonstrations of student understanding.	Development Work with students to develop forms of self-evaluation.
Instructional Strategy Sequence and organize the information as an instructional strategy for delivery.	Instructional Strategy Coaching, modeling, and scaffolding support and challenge the learner to succeed.	Reciprocal Teaching Organize the areas of interest to cover in the topic and sequence in a format to maximize the learning potential.
Selection of Instructional Resources Develop and select instructional resources.	Provide the Problem Manipulation Space Include objects and tools that are required for the learner to manipulate the environment.	Selection of Instructional Resources Identify and select resources to enhance the learning experience and present them to the students. The teacher presents himself or herself as a resource.
Evaluation of Learning Design and conduct a formative evaluation to determine the effectiveness of the instruction. Conduct a summative evaluation to verify the effectiveness of the instructional event.	Evaluation of Learning Evaluate the problem solving process and viability of the solution.	Learner's Self Evaluation Learners conduct self-evaluation based on the contract of the level of personal involvement, self-initiated involvement, and pervasiveness, which shows the significance of the learning experience.
Outcome of the Process Based on assessment scores, formative evaluation, and summative evaluation achievement of the goal can be determined.	Outcome of the Process Outcomes are understanding and further inquiry.	Outcomes of Process 1. Significant Learning 2. Self-actualization 3. Creative product (The learner will show not only an accumulation of knowledge of the topic as well as a creative product but also satisfaction in the learning, desire to master the experience, and a greater understanding of the problem, and potential resolutions)

Conclusions

What are the potential benefits and drawbacks of using a person-centered model of instructional design? By emphasizing students' interests and abilities, courses taught in virtual environments such as certain applications delivered via the WWW, can create an atmosphere of mutual participation and allow for accommodations of various skill and ability levels. Students can exercise the freedom to choose, which is encouraged by the user-controlled hypermedia web environment. By utilizing the person-centered approach in design of instruction, students can take full advantage of the very features of virtual environments that are thought to promote engagement and enhance learning. In other words, the design of instruction using person-centered design is a good fit with a user-controlled, web-based instructional environment such as the one discussed in the case study above.

However, the elements promoting the success of such an approach--user responsibility, ability to be self-assessing and proactive in learning-- are the very elements, when lacking, which will result in an instructional experience that is non-productive at best and frustrating at worst. For example, how will students who have incorrectly assessed their abilities fare in such a free choice environment? Indeed, what kinds of self-assessment tools will need to be available for students (and instructors) to make such appraisals of skill and knowledge? What opportunities or interim assistance is needed to aid these students in fully participating in the course and learning the material? Will students who often expect to obtain course material via lecture and didactic instruction feel cheated

if the instructor relies on them to shape their own course experiences? Will these students have a point? What is the proper role of the instructor?

While the caveats for using a person-centered model are valid, we posit from our initial exploration of the utility of adapting central concepts and principles from Rogers' person-centered approach has shown it to be potentially useful. Designing instruction for virtual, learner-centered courses or learning experiences requires an approach focused on the learner. The use of such approaches may ameliorate the issues raised by the Fordist debate and ensure that on-line courses and virtual communication and collaboration environments develop in ways that truly exploit the instructional potential to develop self-actualized, independent learner.

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Strategies for Creating and Supporting a Community of Learners

Melanie Misanchuk
Tiffany Anderson
Joni Craner
Pam Eddy
Carol L. Smith
Indiana University

Abstract

This paper presents strategies and rationales for implementing certain instructional techniques to move a class from cohort to community. The context is the new Distance Master's program in Instructional Systems Technology at Indiana University. The authors give suggestions for instructional and non-instructional strategies that have students interacting at the levels of discussion, cooperation and collaboration. These strategies are cross-indicated with their intended outcomes, that is, strengthening the feeling of community as defined by a set of characteristics, which are adapted from Schwier (in press). Suggestions for evaluation techniques are also presented, as are questions for further research.

Introduction

The shift from traditional classroom education to computer-mediated distance learning poses enormous challenges to instructors and learners. The concept of the classroom where students meet to interact with other learners and the instructor no longer exists. The instructor can no longer "look" around the room to see if students are attending to the material, bored or confused. Learners lack a natural social outlet to engage with other learners thus leading to feelings of isolation. The learner is now engaged with the computer instead of other learners. The big question for our project is "How do we structure the course design so learners have mechanisms to connect with each other and form community." How do we overcome the characteristics of the medium so that learners feel connected to the instructor and other learners?

The literature on effective teaching and learning promotes several "big ideas" that we used as foundations for our recommendations. These include Vygotsky's (1978) social development theory and the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamson, 1987). Vygotsky's social development theory states that social interaction is vital to cognitive development; all higher-order functions originate as the relationships among individuals. To scaffold learning we must require learners to interact with the content, the teacher and each other. Our strategies focus on promoting communication, social interaction and participation. Many of the principles, theories and strategies we encountered reflect the Seven Principles of Good Practice in Undergraduate education (Chickering & Gamson, 1987). At their core, each of the seven principles focuses on interaction. In 1996, Moore and Kearsley described three types of interactions that are necessary in distance education: learner to learner, leaner to content and learner to instructor. We would argue that these three types of interaction are necessary in education regardless of where or how it takes place.

Characteristics of Community

There is much discussion of learning communities, communities of practices, and virtual or online (social) communities. Although each type of community has its distinct characteristics and requirements, there are many things they share in common. What we are endeavoring to create will be a combination of all of the aforementioned communities: a community of practice (since our cohort will be from the same company) that is involved in mutual learning online. Because of these special characteristics, some things do not apply. For example, there is much talk in the virtual community literature about attracting members and defining the community based on common interests. In our case, this cohort is thrown together and "forced" to form community. Outside members are not encouraged to participate, mainly because the common interest in this case is "taking the Distance Masters in IST from IUB." In a terrestrial community of practice, members might see each other at work, or meet in person once a week to deal with issues in their work lives. This will not exactly be the case for our community; although they will

probably have some work issues in common, they are not a group of "teachers" or "nurses" or "engineers" who share vast amounts of experience and knowledge. Unlike an informal learning community, which spins itself from nothing and is based on a variety of people coming together for informal learning purposes and where the direction of both the learning and the community is malleable, our learning community will exist within strict parameters of this coursework. Obviously, members will be encouraged to bring other experiences and knowledge to bear on their coursework, but at the end of the day, the learning in question will be much more restricted than an informal learning community.

Selznik (1996) identifies seven elements of community: *history, identity, mutuality, plurality, autonomy, participation,* and *integration*. With respect to virtual learning communities, Schwier (in press) adds: an *orientation to the future, technology,* and *learning*. Some of these characteristics of community will be present from the beginning. Others, the cohort will have to grow into. We will describe the features of these 10 characteristics, and discuss how we will use them for our purposes.

Selznik notes that communities are stronger when their members share history and culture, rather than simply abstract general interests. Unlike an established terrestrial community, the nascent community forming from the distance education masters program will not have a shared *history*. Their history, like their identity, will have to grow and develop through their interactions with each other.

We believe that a shared sense of *identity* will develop in this cohort, and will strengthen their communal identity. Schwier's suggested strategies for fostering identity include team-building exercises, developing community logos, and public acknowledgement of individual and group accomplishments within the community. He also notes the importance of articulating the "focus or purpose of the community" and outlining the requirements and rituals. The structure of the courses allows for frequent and obvious reiteration of community focus, and events such as orientation can help the group define its own rituals and norms.

The very fundamentals of a learning community require interdependence and reciprocity, what Selznik terms *mutuality*. Since our focus is on cooperative and collaborative learning, this mutuality will develop naturally. Schwier also recommends asking "leading questions that encourage members of the community to invest in concerns held by other members, and to share ideas and possible solutions" (p. 5). This type of interaction can be encouraged at course-level in the class forum, and on a social level in the Online Café.

We combined Selznik's terms *history, mutuality,* and *identity* into a larger category called *group identity*. By combining these three concepts we emphasize the fundamental importance of group identity in fostering community. Although one of our goals in the next few semesters is to help students begin to construct a history relevant to their community, this is not something that can be imposed upon the group from outside. It has to grow from the sharing of each individual's history and the links that the learners form with each other based on their experiences. These links are characterized by interdependence and reciprocity, in other words mutuality. Group identity results from this history and mutuality, and from making the budding community history public and available to all, especially newcomers.

Plurality, according to Selznik, results when many different types of interactions amongst members of a community occur, often rooted by individuals' membership in other communities (work, neighborhood, church, etc.) that intersect. We replaced *plurality* with *social interaction*. Given a virtual community, one that to some extent is externally imposed, the opportunities for plurality are limited compared to those available to geographic communities. By providing opportunity for and the expectation of social interaction among participants, we purport the program will provide the plurality needed.

Autonomy of individual members within the community, especially within an academic setting, is important to foster. We will encourage thoughtful, personal postings within the forum, to avoid group-think and "me too, I agree" contributions. Students will receive basic instruction on netiquette and will be encouraged to continually address evolving group norms to maintain respectful communication and to build consensus. We use *individual identity* in place of *autonomy* to underscore the importance of both group and individual identities within a virtual learning environment.

In the case of a virtual community, *participation*, both social and academic, is integral. Without active participation in discussions and other class activities, the learner is not part of the community; indeed, the learner does not even "exist." This is one core distinction between being a passive member of a physical community where you are seen and your presence is noted and registered in the minds of others. In a virtual community, you must make a concerted effort to communicate with others in order to exist. At the same time, allowances must be made for learners to shape the participation, both in structure (number/kind of postings) and in content (managing the discussion of subjects interesting to them).

The *future orientation* of a learning community can operate at a number of different levels. A stronger community bond will be formed when a particular cohort goes through a number of courses together, moving

toward their finishing the program and earning a degree. It can be argued that a learning community can develop within the constraints of a single four-month course, but it is much more likely that students will form long-lasting academic and social bonds throughout an entire program. Visioning exercises and direction of learning activities (having participants describe how what they learned will help them in future learning and in their work) can also give the community a focus on the future. In our case, the community's view of the future may be limited to the two or three years they spend in the program. However, it is possible that they will continue to maintain community ties once they have earned they degrees and are working again. It is also possible that members of the Fall 2000 community would end up wanting to remain part of the Distance Masters community after they graduate, and would like to integrate themselves with the new incoming cohorts. This may pose particular problems of negotiation and fit; is there a role for graduated members to "return" virtually and engage with students working through the program?

Schwier notes that "the *nature of the learning* can be broadly defined and contextual"(p. 4) but is a necessary part of a virtual learning community. For our purposes, the learning involved is more specific and structured; the cohort moves through a set of core courses together, in a particular order. Our goal is to foster community among them before they finish the first year, so that although they will go on to take other courses with other distance learners, they will not only maintain ties with their initial cohort community, but will also have learned the foundations of virtual community creation and will use these skills in other classes. We have changed Schwier's term *learning* to *knowledge generation*.

According to Schwier, "communities are built or dismantled by those in the communities, not by the people organizing or managing them" (p. 2). As they mature, communities define their own social rules of conduct and select their own leaders, assuming *ownership* of their governance and norms. Learning communities, note Palloff and Pratt (1999), exhibit evidence of socially constructed meaning, willingness to critically evaluate the work of others, again assuming ownership of their knowledge creation and sharing.

Integration of all of these elements is necessary for a strong community. Schwier suggests creating belief statements and evolving group norms, and adhering to a learner-centered philosophy that "supports individual expression while building a group identity" (p. 5).

Finally, *technology* is an important consideration for us: although it is thanks to certain technologies that virtual community-building is even possible, there are certain limitations put upon the group because of technology. Although it is the conduit for discourse, it can also exclude or discourage people. Tools that are complicated, unavailable for a certain platform, that are slow and cumbersome can all render the discussion process less than ideal, and members who do not actively participate essentially leave the community. Although Schwier recommends using technology compatible with older, less costly equipment to render the community more inclusive, this is not a concern for us.

Based on Selznik's (1996) seven characteristics and Schwier's (in press) additional three characteristics of community, we have assembled the aforementioned six key elements of community. From these elements, we define community as: a group of people who are brought together to share and generate knowledge in a mutually supportive and reciprocal manner. Its characteristics are ownership, social interaction, group identity, individual identity, participation, and knowledge generation. Furthermore, integration of all of these elements is necessary for a strong community.

Having defined some of the particular characteristics of a virtual community, we will now turn to some basic strategies for creating community. Palloff and Pratt (1999) recommend these steps:

- Clearly define the purpose of the group
- Create a distinctive gathering place for the group
- Promote effective leadership from within.
- Define norms and a clear code of conduct.
- Allow for a range of member roles.
- Allow for and facilitate subgroups.
- Allow members to resolve their own disputes (p. 24)

In our case, many of these steps are automatic, but they should still be given careful consideration. For example, the general purpose of the community is defined as "the Fall 2000 cohort for the IST Distance Masters program." However, instructors or organizers may have more specific goals and purposes from the beginning, and even if they do not, other purposes may emerge from the community throughout the term. Pallof and Pratt (1999), surprisingly, do not put much emphasis on the communicative aspect of community without which a virtual learning community cannot exist.

We feel that one of the most important indicators of a learning community is the first: when students communicate not only on an academic level but on a personal level. Working together towards the goals of the course is what they are "supposed" to be doing. When they begin to talk about their personal lives (families, hobbies, jobs), their triumphs and trials with being a distance student (scheduling, technical problems, disagreement with pedagogy), when they seek each other's counsel for other areas of their life (job change, which elective course to take next, family issues), this is the point at which we feel they are comfortable as a community. There is a good chance that not everyone will be everyone else's best friend. However, when a majority of the members feel they are in a safe enough space to "speak up" about things in the public forum, rather than in individual e-mail messages, then this is evidence of a successful community. There may be a few members of the community who do not feel that the Online Café is an appropriate place to discuss non-academic subjects, and it is the role of the mentor and the community members to make the Café a welcoming place for this type of discussion. As in every type of community, there will be some people who opt out of certain discussions, or even out of all "non-official" discussion, but this is quite normal. There will probably be smaller communities within the larger online class, people who form bonds and discuss the course work and their lives, but not on the general forum. These differences can appear for a variety of reasons; Eastmond (1995) found divisions on age, gender, experience, and learning style lines. However, he also found that the groups often transcended age and gender, for example, two characteristics that might, in a traditional classroom, be impediments.

The final step in creation of an online community is to evaluate whether a community has formed, and if so, in what ways has the community aspect contributed to learning. Our project will address methods for performing the first evaluation of whether community has formed.

Definitions

We will examine ways to use certain instructional strategies to work to move the cohort toward a community. We suggest encouraging interaction at three levels: discussion, cooperation, and collaboration.

Cohort

The cohort is the group of students going through the core classes as a group. They may have an initial connection, such as a common employer, but it does not necessarily constitute a strong bond.

Discussion

Discussion is the basic means of communication in an online format. Students must participate in discussion to have any sort of presence in the class whatsoever. Discussion can be focused around readings, lectures, and any other ideas based on course content or course administration. Discussion can occur asynchronously in the SSF or via e-mail, or synchronously via chat rooms or telephone.

Cooperation

Cooperation entails students working in groups or otherwise dividing up tasks. A machine metaphor can illustrate cooperation in the classroom: different parts of the machine perform different functions and goals, but work together towards a similar end. For example, students may divide up a project, but are eventually assigned individual grades for their work. Examples of cooperative tasks include: dividing up sections of a report to write and doing peer review of each other's work.

Collaboration

Collaboration is the most integrated form of group work, and is therefore potentially the most difficult and the most rewarding. In the case of collaboration, the group members work toward a common goal, one that carries a mutual investment. For example, students may each work on every part of the report, consulting each other and re-reading each other's edits. They are invested in every part of the project because they will share a common grade. Examples of collaborative tasks include group writing and creating an ID model.

Community

A virtual learning community, as described in the introduction, is one of the ultimate goals of the core courses. The three levels of interactions can be compared by several characteristics, as in the table below.

	Discussion	**Cooperation**	**Collaboration**
Learning	Information transmission	Knowledge transmission	Knowledge generation
Inquiry	Individual inquiry	Delegation of tasks	Common inquiry
Decision-making	Agree to disagree	Vote (majority rules)	Social negotiation to

			consensus
Goals/agendas	Multiple goals/ multiple agendas	One goal/ multiple agendas	One goal/ one agenda
Accountability	Individual accountability	Individual accountability	Group accountability
Learning relationship	Complete independence	Partial interdependence	Complete interdependence

Description of IST Core

The term "Core" is used in the IST department to denote four courses that all graduate students take in their first year in the program. Traditionally R511 (2 credits), R521/522 (4 credits), R580 (1 credit) are offered in the Fall term; R561 (3 credits) is offered in the Spring. It is usually the case that the new students (both Masters and Doctoral) take these classes as a group; they form a cohort that goes through at least the first year of courses together. The cohort identity is important to the IST program, and it is something that will be actively cultivated in the online Masters program. Tangential to the cohort identity is the community-building that is undertaken to integrate new students into the IST program. The social aspect of the community is nurtured through happy hours, the IST picnic in the fall and the Follies show in the spring, and informal pairing new students with old ones. Academically, the IST community is built through the identity of the Rookie cohort, through the rookies taking non-Core classes (R547, Y520, etc.) with upper year students, through rookie interaction with upper year AIs in Core and non-Core classes, etc. The IST department is also very much linked to its alumni, through alumni presentations in R580 (Grads with Gigs) and networking at conferences.

The pedagogy is rooted in project-based learning and team-based work. Much of the learning is hands-on, and students often work with real-world clients. There is a focus on an integrated curriculum and many of the courses are team-taught. The different research areas of the faculty (for e.g., corporate vs. higher education vs. K-12) expose all students to multiple academic perspectives. The international nature of the program (approximately one-third of the students are non-U.S. citizens) exposes all students to different ways of learning and working. Because of the content, there is an emphasis on technological competence, although the skill levels of both entering and graduating students vary immensely. Although the use of technology in education is important to IST, technology is a means, not an end, and its use is firmly rooted in pedagogy.

The associations that IST has with other departments, including Educational Psychology, Language Education, the Kelly School of Business, the School of Library Science, etc., contribute to an integrated and interdisciplinary academic environment. Most of these departments offer online courses that can be used by Distance Masters students as electives.

Core Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
						Students participate in a face-to-face orientation on campus.	Face-to-face interactions allow to people to create strong initial bonds, which will lead to a greater sense of community right from the beginning.
						Students will learn about online communication, including rules of netiquette	Online communication is vastly different from more traditional forms of communications (Black, 1995).

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
	☛			☛	☛	Students will undergo training in using SiteScape Forum, e-mail, majordomo creation, basic web searches, and MS Word for collaborative writing purposes.	To help reduce barriers to effective learning and establishing social relationships, participants should be given the opportunity to build confidence and competence with the distance education process and supporting technologies (IDE, 2.2).
		☛	☛	☛		Students will post photos of in SiteScape Forum at Orientation.	Connecting people's names and faces is a first big step to forming bonds.
☛	☛		☛	☛	☛	Students will participate in a content-based group project that requires that they negotiate the exact content.	People will form strong personal and academic bonds through shared adversity (Ruhleder, 1999).
			☛	☛		Students will be required to eat lunch as a group two days during Orientation.	People who have a social connection to the group will work better together (Palloff & Pratt, 1999).
			☛	☛		Students will be given the opportunity to participate in at least two evening social activities.	People who have a social connection to the group will work better together (Palloff & Pratt, 1999)
		☛			☛	First posting should be a non-graded/non-credited assignment (e.g. biography).	Students need non-threatening, interesting ways to begin creating online community (Funaro, 1999).
☛	☛	☛	☛	☛	☛	Create an online café that will serve as a non-course-specific conversation area to encourage off-task communication.	People need distinctions between work and play (Palloff & Pratt, 1999).
		☛	☛	☛	☛	Encourage instructor and distance mentors to participate in social interactions, especially in the early stages of the course.	Social interactions between and among learners enrich the learning community and should be supported in the instructional design of the course (IDE, 2.5).
		☛	☛	☛	☛	Students will be encouraged to share, in the online café, information about their non-academic lives, for example, offering mutual support in term of how they are keeping up with their job and school schedule. Students should be encouraged to offer successful strategies to the class.	Reciprocity and help are two important hallmarks of community. Students who take an interest in each other's well being, both academic and social, will have more of a support system of peers than those who do not (Wellman & Gulia, 1999).

R511 Section

Description of R511 (from course syllabus)

R511, Instructional Technology Foundations I, is a two-credit course that has historically been offered each fall semester. This course is required by all IST Masters students and is typically taken concurrently with R521/522, Instructional Design and Development, and R580, IST Colloquium. It is team-taught by two faculty members and one graduate assistant who has taken the course.

The overall objective of this course is to provide a comprehensive introduction to the field and profession of Instructional Technology (IT). Since most entering IST students come from fields other than instructional technology, R511 gives newcomers a sense of history and an explanation of how the components of the field fit together. There is a particular emphasis on the evolution of the "big ideas" of the field.

In the onsite version of R511, class meetings occur once per week in 2-hour sessions. Directed readings compiled in a course packet are provided as practical resources to support assignments and class discussion activities in the course. Most class periods are divided into two portions: 1) During the first hour, each of the three instructors facilitates a group discussion among 15-20 students about assigned readings. 2) The remaining portion of the class time is devoted to further lecture and clarification about topics contained in the readings.

Students are graded according to participation in class discussion, personal synthesis and reflection (as noted in weekly minute-papers collected at the end of each class), three individual written essays (one team-based, two individual), and a final exam or written essay.

R511 Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
					✓	A fundamental element for success for the distance students is an understanding of the key expectations •how much time the course will require •the level of performance that is expected of them •the demands that participating in the core will have on their time.	Students, but especially students learning at a distance, need to have expectations, assumptions, deadlines, etc., made explicit and kept clear (Palloff & Pratt, 1999). Understanding and respecting expecta-tions for participation and performance will be critical to the students' success. Taking Core online will be more demanding than doing it face-to-face.
	✓	✓		✓	✓	Instructors will assign discussion roles (facilitator, summarizer, devil's advocate, etc.) to encourage shy members and force students to think in different ways about the material and about the discussion of the material.	Students should be challenged to engage the material from different perspectives; different roles improve learner-learner interaction and improve learner-material interaction.
	✓		✓		✓	Students will be expected to take part in regular peer reviews by critically evaluating each other's papers.	It is important to develop a critical eye towards other community members' work.
✓	✓				✓	Each week, someone from each group will summarize their group's discussion and post the results for the other groups to read.	Bringing from small groups to the larger group provides for more viewpoints and better discussion.
	✓		✓		✓	Students will be divided into 3-4 small groups for discussion of	Small groups facilitate better discussion (Hiltz, 1998) for

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
						readings and course projects.	learner-material interaction.
✓		✓			✓	Students will fill out weekly "1-minute evaluation" web form, to instructor only. Possible topics include what you liked/disliked about the week's work, how you can transfer this knowledge to your work, and generally how you are feeling.	To better assimilate and process what they have learned, students require a forum to critically reflect on the material and on themselves as learners (Palloff & Pratt, 1999). Keeping in touch with the professor improves learner-faculty interaction.
	✓		✓		✓	Instructors will require high-quality online interactions with peers and discussions of readings by making a portion of the grade dependent on it. (We recommend at least 25%).	Effective learning environments should provide frequent and meaningful interactions among learners. (IDE, 2.1) Good practice encourages cooperation among students (Chickering & Gamson, 1987).
	✓			✓	✓	Instructor and/or mentor will model ways to produce lively, constructive discussion: questions should be open-ended, but focused on students' interpretation of the text.	One of the best ways to keep discussion on topic and students motivated is to participate actively in the conversation (Beaudin 1999).
✓	✓	✓			✓	Instructor will point out excellent discussion, postings, interactions, etc. of other students to continually promote high expectations and model good interaction.	Good practice encourages prompt feedback (Chickering & Gamson, 1987). Faculty-learner interaction improved by attentive professor.
✓			✓	✓		As needed, instructor will revisit netiquette and general interaction issues, and stresses the importance of interacting in a respectful way. Have the community develop group norms based on emergent issues.	Social negotiation leads to the creation of a safe space, which is essential for learning (Palloff & Pratt, 1999).
					✓	Students will be expected to check SiteScape Forum and e-mail every two days and post	Because of the nature of the evolving discussion, students should be constantly engaged in

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
						quality contributions at least twice a week. Participation points will be calculated based on these postings.	the course, without any lengthy absences from discussion. (Caldwell & Taha, 1993)
✓		✓	✓		✓	The instructor/AI should make contact with students who are not actively participating to find out why and address their concerns.	Students need to actively feel like they're part of the community, and that the instructor is interested in their well-being, academic or otherwise (Palloff & Pratt, 1999).
	✓		✓		✓	Students will work together at all three levels of interaction: •Discussion •Cooperation •Collaboration	In order for a newly-formed cohort to move to community, they must change the quality of their interactions. The community should move toward successful use of collaboration, in addition to the continued use of group discussions and cooperative tasks.

R511 Assignment Specifications

Based on the existing assignments for R511, we have developed a set of projects and assignments that will both address the traditional content of the course, and build community based on the discussion, cooperation, and collaboration model. Where we realize that collaboration is a more rich form of thinking and working together, we also emphasize the necessity for students to work at all three levels of interaction throughout the course.

Discussion

•At the beginning of the semester, students will be divided into readings discussion groups of 3-4 people. For purposes of community and continuity, they will remain in these groups throughout the semester.

•In SiteScape Forum, a team will be created for each readings discussion group. The group will manage that space, and can create folders for each week's readings if they so choose.

•The students will be expected to discuss the week's readings in their respective folders. Each student should post at least twice each week.

•The role of facilitator in each discussion group will rotate from week to week. The facilitator must start the conversation, and engage group members to participate.

•The role of summarizer in each discussion group will rotate from week to week. At the end of the week, the summarizer must condense the group's main discussion points, and post them to the class forum (outside the team space).

•There will be a separate folder in SiteScape Forum for discussion of the week's lecture or class activity. These posting requirements will be determined at a later time, dependent on the format of the course lecture material.

Cooperation

"Letter Home" Paper

Students will review each other's papers in formative stages. For the "letter home" assignment, students will post outlines and rough drafts by set deadlines, and a selected group of peers (ideally from outside their reading group) will have to read and give feedback on them. The rationale for a number of small deliverables leading to the final paper is that distance students traditionally need regular deadlines and prompt feedback.

Final Exam Study Guide

Students can still help each other out on breaking down the study guide and elaborating on certain sections of it. This could be left open for students to determine, just as in the traditional R511 class. Simply make the suggestion to the students that they may want to work together on fleshing out the study guide, and leave it to them to decide how they want to do it.

Collaboration

ID Model Paper

The students will collaborate on the ID model paper as in the traditional R511 class (using their reading discussion teams as the groups). In the distance version, however, it will be critical that this process be divided into small deliverables. For instance, the students might be required to break down the task into the following deadlines:

- *Week One:* Each group member must post initial ideas of possible models to evaluate or create. This is not in any formal structure – just a brain dump. Each group member must read and respond to the discussion.
- *Week Two:* Group must decide on a model and begin explicating the model and describing its strengths/weaknesses. All group members should be posting during this week.
- *Week Three:* Someone in the group should summarize the discussion into a paper outline. Another group member should develop a paper draft. One or two group members should make suggested changes and revisions. The final group member should write the final draft and post it.

"ism" Debate

Students will participate in group debates revolving around behaviorism, cognitivism, and constructivism. Ideally, students will be placed into 3 groups that are different from their reading groups. Each group will be assigned one of the "isms" to represent in the debate. Here, a proposed timeline for the debate:

- *Week One:* Individuals will write an informal short paper (one page – perhaps even as a bulleted list) highlighting the major strengths of their "ism" as it applies to distance education courses and will post it for their teammates. Next, the team will enumerate possible rebuttals from the other groups and responses to those arguments. The first week's discussion and postings will all take place inside a new folder established for that team.
- *Week Two:* One student from each group will post an argument about why their position is the best to a debate folder open to the whole class. Each group will respond to each of the other groups.
- *Week Three:* Debate will continue.
- *Week Four:* Each individual will write a brief reflection on how their opinion changed throughout the debate.

Checklist for R511 Instructor/Mentor

Orientation

- [ ] Attend Sunday night dinner with new DE students.
- [ ] Participate in 2-hour R511 class welcome session.

Beginning of Semester

- [ ] Create teams in SiteScape Forum for each readings discussion group. Using a naming structure like jewels (Opal team, Ruby team, etc.) is an easy identifying factor.
    - Divide students into the groups evenly. Make sure the instructor and GA are listed as members of all teams.
- [ ] In SiteScape Forum, create a Discussion & Document Forum entitled "R511 Lecture and Class Activity Discussion."
- [ ] In SiteScape Forum, create a Discussion & Document Forum entitled "R511 Resources & Tidbits"
- [ ] Create a class majordomo.

Weekly

- [ ] Check that all class members have posted at least twice about the readings.
    - If not, make decision about contacting that person via e-mail.
- [ ] Check that all class members have posted about the lecture/class activity.
    - If not, make decision about contacting that person via e-mail.

- ☐ Post some comments to the Online Café. This could be
  - News stories
  - Responses to other students
  - Encouragement
  - Personal comments
  - IST/DE news
- ☐ Reply to at least 2 postings a week, to encourage students to post thoughtful responses and to show that you are present and actively following the discussions.

Before the "ism" Project

- ☐ In SiteScape Forum, create the following three teams: Behaviorism, Cognitivism, and Constructivism.
  - Divide students equally among the three teams. Make sure the instructor and GA are listed as members of all teams.

Before the "Letter Home" Paper

- ☐ In SiteScape Forum, create the following five teams: Peer Review Group 1, Peer Review Group 2, Peer Review Group 3, Peer Review Group 4, and Peer Review Group 5.
  - Divide students equally among the five teams. Make sure the instructor and GA are listed as members of all teams.

R521/522 Section

Description of R521/522 (from course syllabus)

R521/522, Instructional Design and Development, is a four-credit course that has historically been offered each fall semester in an onsite format. This course is required by all IST MS students and is typically taken concurrently with R511, Instructional Technology Foundations I, and R580, IST Colloquium. It is team-taught by at least two faculty members and one or two graduate assistants who have taken the course themselves.
Major content and experience objectives of R521/522:

- Knowledge of instructional design principles
- Knowledge and application of the ADDIE model of instructional design and development
- Understanding and application of simple formative evaluation processes
- Ability to recognize and employ fundamental principles and experiences in team-based approach to project work

Pedagogical methods used in R521/522:

- Task-oriented learning through "authentic" projects
- Diverse, team-based project groups
- Mentor/coach-based instruction for project team support
- Structured timeline of deadlines and deliverables
- Independent learning, i.e., students take responsibility for their own learning
- Assignments with specific criteria that engage students in learning specific course content, with leeway given for students to identify their own topics

Most of the learning in the course occurs within the context of projects and situations similar to those that instructional designers encounter in professional work. Projects are sequenced such that the processes and principles learned in the first ones provide foundation of understanding and competence for progressively more complex ones that follow. This progression of increasingly elaborated projects continues through the academic year into R561, Evaluation and Change Management, and is intended to carry on throughout the student's academic experiences in completing the IST MS program.

In the onsite version of R521/522, class meetings occur twice per week in 2.5 -hour sessions. Class sessions involve one or more of a variety of activities, including lectures or presentations about specific topics, readings discussions, project group meeting time, group project presentation, or hands-on design activities. Directed readings compiled in a course packet are referenced as practical resources to support projects and class discussion activities in the course.

The instructors believe that people learn best when they are highly motivated and actively engaged in learning tasks, that learning is most useful when it is directly related to learner needs. Thus, students are expected to take responsibility for their own learning. The course begins with a fair amount of guidance from the instructors, in

terms of what information to access and how to facilitate personal learning, then gradually decreases that guidance to require students to actively seek resources on their own to perform the assigned tasks.

Major projects in R521/522 are completed by groups of three students, each mentored by an assigned instructor "coach." To perform most satisfactorily in the course, students must spend many hours per week outside of class developing and completing these projects. At the completion of a project, each member of a given group is awarded the same grade (a "group grade") as his/her teammates. Approximately twenty percent of that grade is awarded for the deliverable produced in the project (e.g., the instructional tool developed and a design report), whereas the remaining portion of the grade is awarded according to the way members worked within the team setting. Some students come into the program with extensive background in true teamwork, but most do not. Thus, the instructors devote a portion of instructional time early in the semester toward preparing students for the team experience. Throughout the duration of each project, group coaches continue to offer advice and guidance for the team process.

R521/522 Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
	✓					Learners will be divided into 3-4 groups for discussion of readings and course projects.	Small groups facilitate better discussion. (Hiltz, 1998)
✓	✓		✓		✓	Provide criteria that define appropriate course topics, leaving room for choice and opportunities to leverage work-related projects as course projects. • Learners select a topic and procedure for project. • Each team selects 4 readings to read and summarize for the whole class (for discussion)	In order to build community, learners need ownership. (Schwier, in press)
✓	✓				✓	Each week, someone from each group will summarize their group's discussion and post the results for the other groups to read.	Bringing from small groups to the larger group provides for more viewpoints and better discussion.
	✓		✓		✓	Students will be divided into 3-4 small groups for discussion of readings and course projects.	Small groups facilitate better discussion (Hiltz, 1998) for learner-material interaction.
	✓		✓		✓	Instructional activities will require the learner to actively participate in the acquisition and processing of educational content. • Team-based authentic projects where the learners learn by doing. • Discussing readings online and	To better assimilate and process what they have learned, students require a forum to critically reflect on the material and on themselves as learners (Palloff & Pratt, 1999). Keeping in touch with the

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
						role-playing. • Require high-quality online interactions with peers and discussions of readings by making a portions of the grade dependent on it (25% recommended) • Groups will be responsible for posting some of their work in progress (e.g., each group posts a description of a different aspect of ADDIE). • Instructor should use open-ended questions to encourage dialogue. • Ask learners to provide URLs that enhance learning.	professor improves learner-faculty interaction.
	☛				☛	Instructor will phone each learner before class begins. (Spear & Bruce, 1997)	One-on-one verbal communication between learner and instructor solidifies relationship.
	☛				☛	Establish a virtual office hour: one hour where instructor will be available for online chats, office phone calls, or e-mail. Inform learners of the faculty member's expected e-mail or voicemail response time, e.g., within 24 hours, twice a week, etc. (Spear & Bruce, 1997) (Spear & Bruce, 1997)	Students like to know the professor is available at a particular time to address e-mail concerns.
				☛	☛	Instructor will be proactive, following up on the learner who is not participating in chats, discussions, etc.	In the distance format, it is easy for students to lose touch with the class and slowly drop out. Active intervention from the instructor can lessen attriction.
☛	☛		☛	☛		Conduct a phone conference with each team at least once during the development of each project.	Verbal communication between the team and instructor solidifies relationship and makes for easier clarification.
☛	☛				☛	Invite other professors to lead discussions (Davies and Reigeluth on concept learning) where learners can interact	Students will appreciate input from experts in the field. The will feel less isolated from the rest of the department when they can

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Parti*	**Strategies**	**Rationale**
						directly with experts to deepen understanding.	interact with other instructors.

R521 Assignment Specifications

Based on the existing assignments for R521, we have developed a set of projects and assignments that will both address the traditional content of the course and build community based on the discussion, cooperation, and collaboration model. The students will collaborate on production projects, discuss readings or lecture topics, and reflect on activities and experiences throughout the course. While we realize that collaboration is the richest form of thinking and working together, we also emphasize the necessity for students to work at all three levels of interaction throughout the course.

Discussion

Readings

Discussion activities centered around the course's major themes (e.g., usability, design, evaluation).

- At the beginning of the semester, students will be divided into readings discussion groups of 5 people (different from those in their project groups). For purposes of community and continuity, they will remain in these groups throughout the semester.
- In SiteScape Forum, a team will be created for each readings discussion group. The group will manage that space, and can create folders for each week's readings if they so choose.
- The students will be expected to discuss the assigned readings in their respective folders. Each student should post at least twice each week.
- The role of facilitator in each discussion group will rotate from assignment to assignment. The facilitator must start the conversation, and engage group members to participate.
- The role of summarizer in each discussion group will rotate from assignment to assignment. At the end, the summarizer must condense the group's main discussion points, and post them to the class forum (outside the team space).

Cooperation

Group projects

- At the beginning of each project, students will be divided into groups of three. Each group will work collectively to complete its own project. A team "coach" (an instructor or graduate assistant) will be assigned to each group to offer advice and guidance for the team process.
- In SiteScape Forum, a team will be created for each project group (including the course instructors and mentors). The group will manage that space.
- Groups will be required to post all team meeting summaries and other artifacts of their team processes on the forum.

Collaboration

Group projects For each project, the team will be intentionally diverse in gender, nationality and/or job background as much as possible to encourage multiple points of view.

- Projects will be assigned group grades, a large portion of which is assigned to the "group process."
- Give project rubrics, teams will be encouraged to brainstorm possible topics and come to consensus to identify their own topics for projects.
- Teams will engage in formative peer reviews of each others' projects and materials for projects throughout the course.
- Lectures and course topics will be presented by different instructors throughout the course, providing a model of collaboration for students.

Checklist for R521 Instructor/Mentor

Orientation

- ☐ Attend Sunday night dinner with new DE students.
- ☐ Coordinate a team-based project that emulates the required peer interaction and interdependence and time-limited working tensions of R521 production projects.
- ☐ Post expectations (time, participation, assignments, dates)

Beginning of Semester

- ☐ Create teams in SiteScape Forum for each readings discussion group.
  - Divide students into the groups evenly. Make sure the instructor and GA are included as members of all teams.
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled "R521 Lecture and Class Activity Discussion."
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled "R521 Resources & Tidbits"
- ☐ Create a class majordomo listserv and direct all class members to subscribe to it.

Weekly

- ☐ Post some comments to the Online Café. This could be
  - News stories
  - Responses to other students
  - Encouragement
  - Personal comments
  - This week in IST
  - Post reflection questions each week

Beginning of Each Project

- ☐ Create teams in SiteScape Forum for each project group.
  - Divide students into the groups evenly. Make sure the instructor and GA are included as members of all teams.
- ☐ Direct each team to construct and post its own individualized strategies and timeline for conducting the team process and completing its project.

Throughout Project

- ☐ Check that each project team is posting evidence of cooperative work on project at least once per week.
  - If not, make decision about contacting that group via e-mail.
- ☐ Reply to at least 1 or 2 postings a week per group, to encourage students to post thoughtful responses and to show that you are present and actively following the discussions
- ☐ Check that all team members are participating at least once every two weeks within their own project teams

End of Project

- ☐ Review reflection essays from each team member about lessons learned from the production and team processes
- ☐ Collect peer grading of team members' participation within each team

Evaluation

The final step in the creation of a learning community in these courses is to evaluate whether such a community has formed and, if so, in what ways the community aspect has contributed to learning. We are basing our strategies for evaluating the success of community-building in these courses on Palloff & Pratt's (1999) indicators that an online community has been forming:

- Active interaction involving both course content and personal communication.
- Collaborative learning evidenced by comments directed primarily student to student rather than student to instructor.
- Socially constructed meaning evidenced by agreement or questioning, with the intent to achieve agreement among students.
- Sharing of resources among students

- Expressions of support and encouragement exchanged between students, as well as willingness to critically evaluate the work of others. (p. 32)

The course evaluations will take two forms: Formative evaluations are undertaken throughout the course so that necessary adjustments in course delivery and activities can be identified and made. Summative evaluations are performed at the conclusion of the course to measure final learning outcomes and student satisfaction. Both forms provide fundamental indicators of the overall success of the course and its participants in meeting the initially stated objectives. Palloff & Pratt recommend employing evaluations over three distinct elements of a online course: student performance and learning, effectiveness of the course in supporting student learning objectives, and overall student experiences of the students in working in an online environment. For our purposes of assessing community formation, the emphasis on student performance is most the most important factor on which to focus.

We have stated already that two key indicators that the evolution of a community has occurred are evidence of participants accepting ownership of the community and realizing a shared identity. The metaphor of scaffolding activities and course strategies as mechanisms to foster community implies that the instructor provides models and activities to course members through which they exercise community-like tasks and interactions. These scaffolds are erected as temporary measures to support the desired behavioral outcomes until observed behavior indicates they are no longer used or needed, then they are gradually removed. Concurrently, formative evaluation that measures indicators of the extent to which online community is occurring becomes the key factor in determining the necessity and lifespan of each scaffolding device.

Suggested methods for formatively assessing the level of online community throughout the duration of the courses are as follows:

- Continually monitor the amount, type and effectiveness of discussion in all media, particularly student-to-student discussion
- Administer periodic interviews and web-based questionnairesto students to gather qualitative feedback about reactions to the level of community they are experiencing and its usefulness to their learning
- Look for evidence within all communication media of resource sharing and/or inter-community encouragement or support
- Compare progression of reflective essays of students to identify evolution of self-assessments that indicate personal commitment to the community or deepening of learning and thought about key issues discussed among members

We do not anticipate that a mature community will have been generated from this one semester alone. However, we do expect that the R521 and R511 experiences of these students will create a solid foundation of an infant community that will continue evolving throughout their career in the IST DE MS program. Summative evaluation in the context of assessing community building is useful for determining the overall effectiveness of the online community environment on the students' experiences both during these courses and in future ones.

Suggested methods of summative evaluation are as follows:

- Compare pre-and post-course attitudes of students regarding confidence with working collaboratively with a distributed or online project team
- Compare pre- and post-course opinions of students regarding their comfort levels with and reactions to collaborative projects
- Assign a final reflective essay in which students describe a personal action plan for applying the experiences and knowledge gained through the course, specifically those relating to collaboration and communities
- Perform longer-range (e.g., 2-3 months later) follow up interviews and surveys with students that engage them in reflection on the impact of community and collaboration on courses taken after R521 and r511

Finally, we intend these strategies of evaluating community building in R521 and R511, although holistic in spirit, merely as a framework on which more specific and precise assessments can be constructed. We believe deeper exploration of success factors in fostering online community would be a very fertile topic for further research and warrants further investigation.

Questions for Further Research

Beyond the evaluation of the success or failure of community in the Fall 2000 Distance Masters Core, there are other topics worthy of research.

- What are some valid measures of community development?
- If community formed, what was its effect on the learning?
- How can learners be motivated to take part in virtual academic or social community activities?

- What are special features of "forced community" like the Masters cohort?
- What is the expected/observed life cycle of the Distance Masters learning community?
- How does this community develop and maintain its history?
- Should the Distance community be integrated with the residential graduate community? If so, in both academic and social ways? If so, how can this be accomplished?
- How can the community best be mentored?
- What are the different roles for instructors, graduate assistants, volunteers, upper-year IST students, etc?
- What communication/collaboration tools foster the development of a learning community?
- What are the best practices for using existing communication tools in distance education?
- What tool features lend themselves to different aspects of collaboration and community-building?
- How appropriate were the tools chosen for Fall 2000 in terms of collaboration and community formation?

Conclusion

Having determined that richer learning takes place within the context of a learning community, this report provides background descriptions of characteristics of community and, more specifically, a virtual learning community. We discuss the goal of moving a cohort to a learning community through scaffolding activities rooted in the communication formats of discussion, cooperation, and collaboration.

The report then treats the Core classes in three separate sections: Core (principally orientation and the online café), R511, and R521/522. The courses are described, instructional strategies and rationales are presented, possible assignments are detailed, and an instructor checklist is provided.

Finally we thought it necessary to determine some strategies to evaluate a) whether community has formed within the cohort, and b) in what ways the community contributed to deeper learning. We also provide some possible topics for further study.

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Analysis of a Customized Intervention for the Development of a Web-based Lesson by Pre-service Teachers

G. Brandon Murry
Francie R. Murry
University of Northern Colorado

Abstract

This study compared the use of two developmental alternatives: a Web Editor (WE) in combination with a *customized template/shell (Teaching Not Teching, T-N-T) and a Web Editor (WE) only, for development of a Web-based lesson by pre-service teachers. Six hypotheses were tested to find whether the WE + T-N-T alternative was more efficient, effective, and appealing than the WE only development alternative. The efficiency, effectiveness, and appeal of developing a Web-based lesson was examined using these variables; lesson creation time, perceived effort, inclusion of six specified instructional components, functionality of six specified technical components, teacher appeal, and likelihood of intended future use (dependent variables) and the lessons development alternatives WE + T-N-T or WE only (independent variable).*

A quasi-experimental design and t-test analyses were employed. Pre-service teachers (N = 103) were assigned to one of the two development alternatives. Instruments included researcher-developed evaluations, self-report tools and the Computer Attitude Scale (CAS). Dependent variables investigated in this study include: lesson creation time, perceived effort, inclusion of six specified instructional components, functionality of six technical components, teacher appeal, and rate of future use. Statistical analysis of six hypotheses confirmed that developing Web-based lessons using WE + T-N-T was more effective than using WE only. The analysis also revealed that neither developmental alternative was superior in terms of efficiency or appeal.

Purpose of the Study

A report from the National Center for Educational Statistics (NCES) (1999) details that although educational technology is considered a means for transforming education, only 20% of teachers feel well prepared to integrate technology into classroom instruction. This study examines a tool for promoting technology integration through pre-service teacher skill acquisition and application of Web-based lesson development when presented through two different alternatives (WE + T-N-T and WE only). This study investigated whether using a Web editor (WE) in conjunction with a custom created template/shell (T-N-T: Teaching Not Teching) is more efficient, effective, and appealing for pre-service teachers to use in the development of Web-based lessons than using a Web editor only. The WE used in this study was Microsoft FrontPage 2000.

Each pre-service teacher created a Web-based lesson using one of two lesson development alternatives. The Web-based lessons were then evaluated using three criteria: efficiency, effectiveness, and appeal. Comparison of 16 variables/sub-variables was made between lessons created with WE + T-N-T and WE only.

The three criteria for usability was applied in the evaluation phase to determine if one Web-based lesson development alternative provides better support for pre-service teachers compared to another alternative. Teachers must have access to technological innovations that help them meet the needs of a diverse audience, get the job done quickly, and have the ability to integrate best practices into the interface design and lesson content.

Description of the Sample

During the 1999-2000 Fall Semester, 161 pre-service teachers were enrolled in four sections of ET 347 Educational Technology Applications for Elementary Teaching, one section of ET 348 Educational Technology Applications for Middle Grades Teaching, and three sections of ET 349 Educational Technology Applications for Secondary Teaching. All of these students were invited to participate in this study. Permission to participate was received from a total of 144 students. Each student completed the Demographics Questionnaire and the Consent Form during the first class session. Of the 144 students in the study, half were identified as the Control group while the remaining students were identified as the Treatment group.

The groups were selected by nonrandom methods; however, the intact sections were randomly assigned to treatment groups. Two of the four sections of ET 347 (elementary pre-service teachers) were randomly assigned to the Control group and the remaining two sections were assigned to the Treatment group. Two groups of ET 349

(secondary pre-service teachers) were drawn and assigned to the Control and one remaining section of ET 349 and one section of ET 348 (middle grades pre-service teachers) were assigned to the Treatment group.

Forty-one of the 144 students (28.47%) who had agreed to participate in the study either did not complete their Web-based lesson or other required instruments and subsequently were eliminated from the study. Thus, this study's sample consisted of 103 students, that is, 64% of the Educational Technology students who initially had been invited to participate. Final group size for the Control group was 52 and for the Treatment group was 51.

The intact class sizes ranged from 16 to 26 students. The classes were scheduled for 50 minutes and met on the following days and times; two Monday classes at 12:20 and 1:25 PM, one Tuesday class at 9:05 AM, three Wednesday classes at 8:00 AM, 12:20, and 1:25 PM, one Thursday class at 6:00 PM, and one Friday class at 10:10 AM.

Research Questions

The research questions were centralized around the usability/evaluation criteria efficiency, effectiveness, and appeal as follows:

Efficiency

RQ_1: Are pre-service teachers able to develop a Web-based lesson in less time when they use WE + T-N-T than when they develop a Web-based lesson using WE only?

RQ_2: Will pre-service teachers perceive that less effort is required by using WE + T-N-T than when they develop Web-based lessons using WE only?

Effectiveness

RQ_3: Are the six specified instructional components (lesson goal(s), objectives written in performance-based terms, student performance, student performance evaluation, student-to-teacher contact, and location cues in the site) present when pre-service teachers develop a Web-based lesson using WE + T-N-T and when using WE only?

RQ_4: If present, which of the six specified technical components (navigation, image presence, mailto links, interactive mechanism, audio and video) are functional when pre-service teachers develop a Web-based lesson using WE + T-N-T and when using WE only?

Appeal

RQ_5: What degree of teacher appeal is elicited from pre-service teachers' interaction with the development process of a Web-based lesson using WE + T-N-T and from pre-service teachers who use WE only?

RQ_6: Do pre-service teachers intend to continue Web-based lesson development with the lesson development alternative they used in the study in their future instructional settings?

Research Design

This study is quasi-experimental (Smith & Glass, 1987). That is, the independent variable is an introduced treatment, although there will not be total control over which participants receive which treatment. Participants were selected by nonrandom methods and then the intact sections were randomly assigned to treatment groups. This research paradigm may be represented as follows:

Group I WE only	R	O_1		O_2
Group II WE + T-N-T	R	O_1	X	O_2

R = Random assignment of treatment to intact classes, Consent Form, Demographic Questionnaire

O_1 = Instruction on how to use the Web editor

X = Intervention treatment (T-N-T)

O_2 = Work Time-Log, Effort Questionnaire, Instructional Components Evaluation Checklist, Technical Components Evaluation Checklist, Computer Attitude Scale (CAS), and Intended Future Use Questionnaire, Summary Data Sheet

Data Analysis

Results regarding the evaluation of the Web-based lessons created with a Web editor combined with a template/shell structure from "Teaching-Not-Teching" (T-N-T) and those created using a Web editor (WE) only developed by pre-service teachers are presented in this section. The evaluation was based on the comparison criterion of efficiency, effectiveness and appeal. These variables were comprised of 16 sub-variables.

The t-test was used to analyze the data and determine if there was a significant difference between the Control and Treatment groups as measured by the 16 identified sub-variables. This study used six independent t-tests; therefore the probability of one or more Type-I errors was greater than the alpha set for any single t-test. Due to the multiple t-test error rate occurring from six t-tests, an alpha level of .0167 was set for each test resulting in an overall experiment-wise alpha of not more than .10. Given the exploratory nature of the study, this error range was judged appropriate. The research null hypotheses are presented with the related analyses and results.

H_{O1}: There is no statistically significant difference between length of time required to develop a Web-based lesson using WE + T-N-T compared to using WE only.

Based on the results of the independent t-test, H_{O1} was retained, indicating there was no difference in the time required by pre-service teachers to create a Web-based lesson using WE + T-N-T than when using WE only ($t = -0.9457$, $p = 0.1733$). Data were compiled and analyzed from the Work Time-Log. The results are presented in Table 1.

Table 1. Work Time-Log

Group	Mean Time (minutes)	SD (minutes)	df	p
Treatment ($n = 51$)	519.1764	215.3836	101	0.1733
Control ($n = 52$)	476.5384	241.1787		

Participants in the study used the Work Time-Log to record the number of minutes they spent designing and developing their Web-based lesson. The six specific tasks itemized on the Work Time-Log were: 1) Tinkering with the computer program, 2) Storyboarding, 3) Collecting images, audio, video, and other cool stuff, 4) Thinking about my Web-based lesson, 5) Collecting or creating lesson content, and 6) Developing Web-based lesson with the editor. Although there was not statistical significance between the total number of minutes participants from each group took to complete their lesson, participants in the Treatment group spent, on average, 43 more minutes than did the participants from the Control group.

H_{O2}: There is no statistically significant difference between perceived required effort when using WE + T-N-T compared to when WE only is used by pre-service teachers to develop a Web-based lesson.

H_{O2} was retained, suggesting no difference in the perceived effort by pre-service teachers when developing a Web-based lesson using WE + T-N-T than when using WE only ($t = 1.8673$, $p = 0.0324$). Data for this comparison were compiled from the Effort Questionnaire. The results of this analysis are found in Table 2

Table2. Perceived Effort

Group	Mean Effort	SD	df	p
Treatment ($n = 51$)	7.0588	1.9226	101	0.0324
Control ($n = 52$)	6.3750	1.7928		

H_{O3}: There will be no statistically significant difference between the frequency of presence of the six specified instructional components (e.g., lesson goal(s), objectives written in performance-based terms, student performance activity, student performance evaluation, student-to-teacher contact, and location cues in the site) in a Web-based lesson when developed by pre-service teachers using WE + T-N-T than when developed using WE only.

H_{O3} was rejected, indicating a significant statistical difference between the frequency of presence of the six specified instructional components in a Web-based lesson developed by pre-service teachers utilizing WE + T-N-T than when developed using WE only ($t = 18.5048$, $p = 0.0000$). Data were derived from a scale that ranged from a low of zero points to a high of six points. The data indicated a statistical favor for the WE + T-N-T group. See Table 3 to review the results.

Table3. Instructional Components

Group	Mean Score	SD	df	p
Treatment ($n = 51$)	5.3333	0.9933	101	0.0000*
Control ($n = 52$)	2.1153	0.7586		

* = $\alpha < 0.0167$

The six specific instructional components itemized on the Instructional Components Evaluation Checklist are as follows: 1) Lesson goal(s), 2) Objectives written in performance-based terms, 3) Student performance activity, 4) Student performance evaluation, 5) Student-to-teacher contact, and 6) User-location within the site cues. The Treatment group scored higher than the Control group on all six instructional components. Not one Web-based lesson developed by the participants in the Control group included Objectives written in performance-based terms, or Student performance activity, or Student performance evaluation.

Some participants from the Control group and the Treatment group designed what resembled an activity and/or quiz in their Web-based lesson but did not receive points for these components on the Instructional Components Evaluation Checklist. Operational definitions of these three variables follow.

Objectives written in performance-based terms: refers to a statement that describes what learners should be able to do when they have completed the lesson. "What learners 'do' must be observable so that the learners know that they have learned and what they have learned" (Smith & Ragan, 1993, p. 91).

Student performance activity: refers to eliciting specific behavior from the student based on the performance objectives for the lesson.

Student performance evaluation: refers to supplying the student with feedback on their performance based upon student performance activity.

The protocol in awarding points for these three variables was to first look for objectives written in performance-based terms. The performance objectives are the foundation for the other two variables and if there were no performance objectives contained in the lesson there could be no points awarded for either "student performance activity" or "student performance evaluation." As stated a-priori in the definition of “student performance activity,” performance was based upon stated objectives and if objectives did not exist in the lesson no points were awarded for student performance activity. Furthermore, no points could be awarded for student performance evaluation, because as stated a-priori in the definition, “student performance evaluation is to be based upon student performance activity.”

H_{O4}: There will be no statistically significant difference between the frequency of functionality when the six specified technical components (e.g., navigation, image presence, mailto links, interactive mechanism, audio and video) are developed by pre-service teachers utilizing WE + T-N-T than when developed using WE only.

H_{O4} was rejected, indicating significant statistical difference between the frequency of functionality of the six specified technical components: 1) Navigation, 2) Image presence, 3) Mailto links, 4) Interactive mechanism, 5) Audio, and 6) Video in Web-based lessons when developed by pre-service teachers utilizing WE + T-N-T than when developed using WE only ($t = 9.7680$, $p = 0.0000$). Data are derived from a scale that ranged from a low of zero points to a high of six points. The statistical preference was in favor of the WE + T-N-T.
T-N-T group. The results can be found in the following.

Table 4. Technical Components

Group	Mean Score	SD	df	p
Treatment ($\underline{n}$ = 51)	3.4901	0.6744	101	0.0000*
Control ($\underline{n}$ = 52)	2.0769	0.7883		

* = $\alpha < 0.0167$

The scores on the Technical Components Evaluation Checklist were based on functionality of the six specified technical components. Not one participant from either the Treatment or the Control group attempted to include component 5) Audio or 6) Video in their lesson. Of the four remaining technical components, the Treatment group scored higher on average in every component.

H_{O5}: There will be no statistically significant difference in the degree of teacher appeal expressed by pre-service teachers using WE + T-N-T toward developing Web-based lessons than from pre-service teachers using WE only.

H_{O5} was retained, indicating no statistically significant difference between the degree of positive teacher appeal from pre-service teachers using WE + T-N-T to develop Web-based lessons than from those using WE only ($\underline{t}$ = -0.6403, p = 0.2617). Data were compiled and analyzed from the Computer Attitude Scale (CAS). The four areas associated with the CAS (low anxiety, high confidence, liking, usefulness) revealed no statistically significant differences between the two groups. The results can be found in Table 5.

Table 5. Computer Anxiety Scale

Group	Mean Degree of Appeal	SD	df	p
Treatment ($\underline{n}$ = 51)	118.2450	16.7980	101	0.2617
Control ($\underline{n}$ = 52)	120.4807	18.5723		

H_{O6}: There will be no statistically significant difference between the likelihood of pre-service teachers' anticipation for developing Web-based lessons with either alternative in their future instructional settings.

H_{O6} is retained, suggesting no statistically significant difference in the anticipated future instructional development of Web-based lessons by pre-service teachers using WE + T-N-T to develop Web-based lessons or those using WE only ($\underline{t}$ = -0.3946, p = 0.3470). Data were compiled and analyzed from the Intended Future Use Questionnaire. See the results displayed in Table 6.

Table 6. Intended Future Use of Development Alternative

Group	Mean Score	SD	df	p
Treatment ($\underline{n}$ = 51)	8.4019	1.9053	94.3	0.3470
Control ($\underline{n}$ = 52)	8.5769	2.5540		

Appeal of the design/development process was addressed through the statistical examination of H_{O5} and H_{O6}. There was no statistical significance in the differences between the Control group and the Treatment group on H_{O5} or H_{O6}.

Talk-Aloud Interviews

The post-hoc talk-aloud interviews were completed by telephone with students from both the Control and Treatment groups. Two students were selected from each group based on most and least time recorded on the Work Time-Log. Two students from each group were also selected based on the highest and lowest compiled scores of the remaining five instruments (Effort Questionnaire, Instructional Components Evaluation Checklist, Technical Components Evaluation Checklist, Computer Attitude Scale, Intended Future Use Questionnaire). In theory, eight talk-aloud interviews would be performed, however, one of the individuals identified from the Control group fit in two categories (least time spent as recorded on the Work Time-Log and high composite score on the remaining five instruments), and therefore only seven participants were interviewed.

Data obtained from the anecdotal talk-aloud interviews revealed that one participant from the Treatment group had continued using the T-N-T template/shell after the study ended. He had recently completed his seventh lesson in only 20 minutes. His completion time for the initial use of T-N-T was 450 minutes. Although this finding is based upon a single data point, the substantial, reduction in development time needs to be explored further to determine if multiple use of the WE + T-N-T template and WE only results in similar outcomes.

Limitations

Due to several factors, the researcher or reader would be vulnerable in drawing direct conclusions from the results of this study. The following limitations of this study should be considered when attempting to generalize from the findings and/or to replicate the study.

The primary limitation of this study was the failure of the Control group to develop Web-based lessons that included the lesson components as defined within this study. According to the PTEP methods course syllabus, lessons components include goals, objectives, activities and performance evaluation. The Control group did not include these lesson components in the Web sites they created. Without such instructional components, the nature of the sites created is much more informational rather than instructional/educational. Had the Control group been required to rework their lessons so that the lessons included instructional components, the results of the comparisons between the Control group and Treatment group in regard to the efficiency (time and effort) and appeal (low anxiety, high confidence, liking, usefulness and intended future use) may have been substantially different.

Restricting this study to a university setting is the greatest strength while also being the greatest weakness. Template design and interaction of pre-service teachers may not reflect the views of students at other universities, smaller or larger colleges, and/or community colleges. The university setting, however, offers the opportunity to assess students' perspective as they create and layout their lessons using the template format. Ability to generalize is largely limited due to the sample selection.

A third limitation is that this study uses a self-report. Self-reports are susceptible to "error" through the difficulty of eliciting honest, accurate responses. In this study, the participants are not under pressure to produce in order to be paid; nor are they reporting on an issue that will influence their grade, although they may be under a certain amount of time constraint pressure because of their own organizational capabilities. The assignment will be graded "Pass" or "Fail" based upon criteria in the grading rubric; student input from the self-report is not part of the grading criteria. These factors still do not guarantee the truthfulness of the responses. However, they do alleviate the pressure and stress to answer with "teacher pleasing" responses.

A final limitation of this study is control for experimenter contamination. The intervention, T-N-T Web-based lesson template/shell, was designed and developed by the researcher and unquestionably there is researcher bias. The instruction for using the Web editor and the instruction for using T-N-T will be presented by the researcher. Maintaining fidelity during lesson presentation is a limitation. To minimize this limitation, adherence to guidelines for each scripted lesson will be described in Chapter Three. Another aspect of experimenter contamination is that data collection and data analysis is conducted solely by the researcher and subject to researcher bias. To minimize this limitation, the participants complete four of the six instruments. Of the remaining two instruments one is scored based solely upon component presence and the other is scored based solely upon component functionality.

Description of the T-N-T Template/Shell

Essentially, the lesson template/shell is a complete Web-based lesson minus the content. The template/shell exists as a Web-based resource/tool for the teacher. This template/shell is designed to support a pedagogically sound linear presentation of materials and activities while concomitantly providing a multiplicity of instructional scaffolding cues designed to guide development of the content. Below are screen captures of two pages from the template.

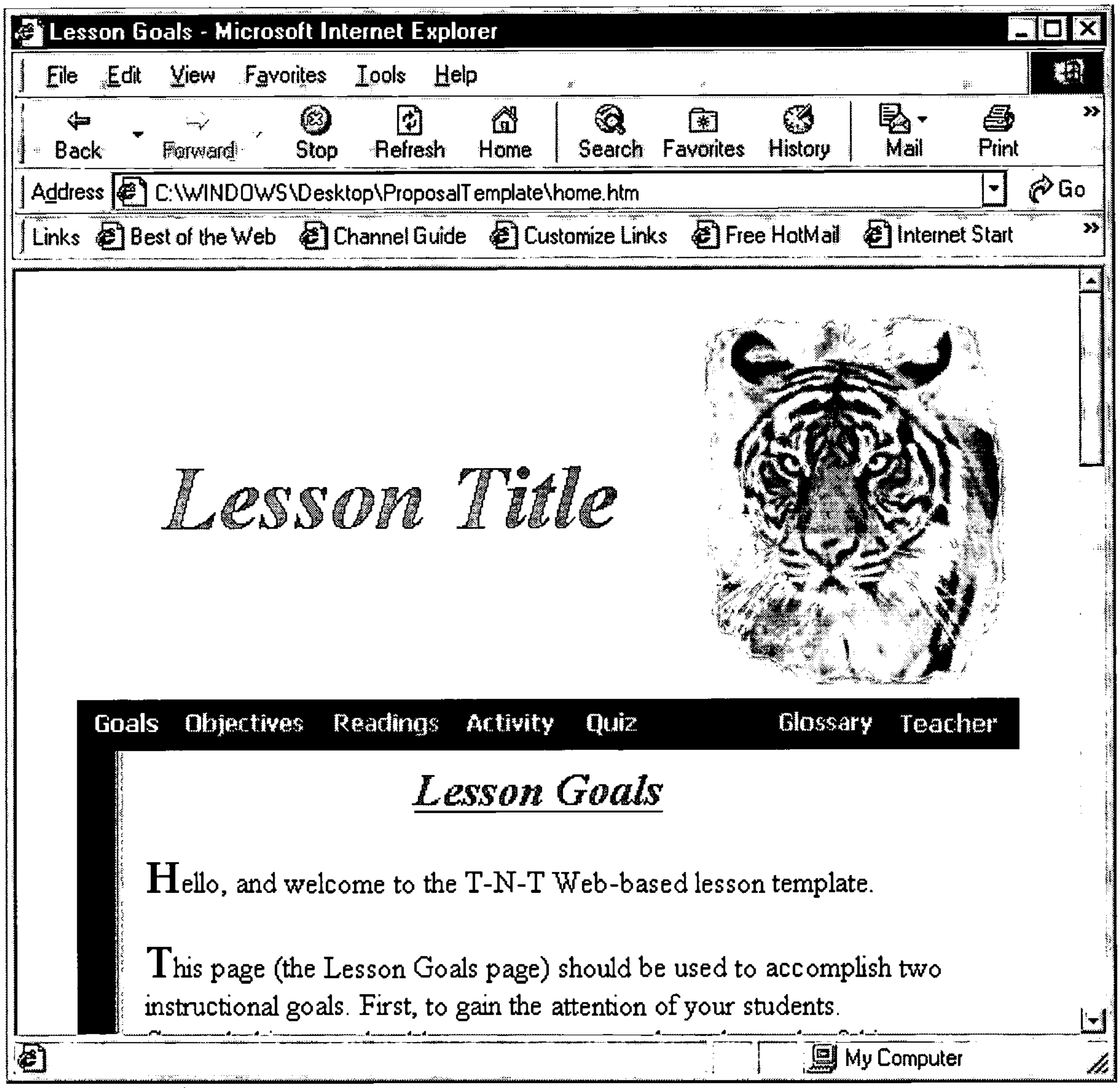

Figure 1. Screen Capture of the Navigation Bar

The navigation bar includes seven links (Goals, Objectives, Readings, Activity, Quiz, Glossary and Teacher). Note that "Goals" is white (inactive link) and the others are red (active links). White text is a visual cue that the user is working in the Goals section. The title "Lesson Goals" directly below the navigation bar is another indicator of location and page purpose. Scrolling down the Lesson Goals page reveals a few lines of direct instruction to the developer.

Each page of the template (excluding Glossary and Quiz) includes such direct instruction and a brief rationale (theoretical foundation) for the suggested approach to content development within each part of the Web-based lesson. The "Glossary" and "Teacher" links are set apart within the navigation bar. This segregation is

intentional as glossary and teacher sections are provided as Tools for the teacher/designer and not as having the same instructional rationale/purpose as the other five components of the lesson. The one link located on the navigation bar that does not open a Web page is titled "Teacher." This link is an E-mail link to the instructor.

The lesson template also includes a ready-to-use ten question multiple-choice quiz. The interactive "Quiz" is a JavaScript program that solicits the user to answer questions relevant to the lesson content and receive immediate feedback on their performance.

When providing content for the Quiz section of the lesson, the teacher/designer is prompted to insert questions pertaining to the lesson and potential answers (correct and incorrect). The feedback section of the Quiz is a program designed to give students appropriate information about their performance. Note that in the following screen capture, answers to the various questions have been selected and the user has clicked on the "Calculate Results" button.

The student performance feedback section of the Quiz page provides the student two sets of information. First, it furnishes a text-based assessment of their performance and secondly it allows the student to see which questions they answer correctly and incorrectly.

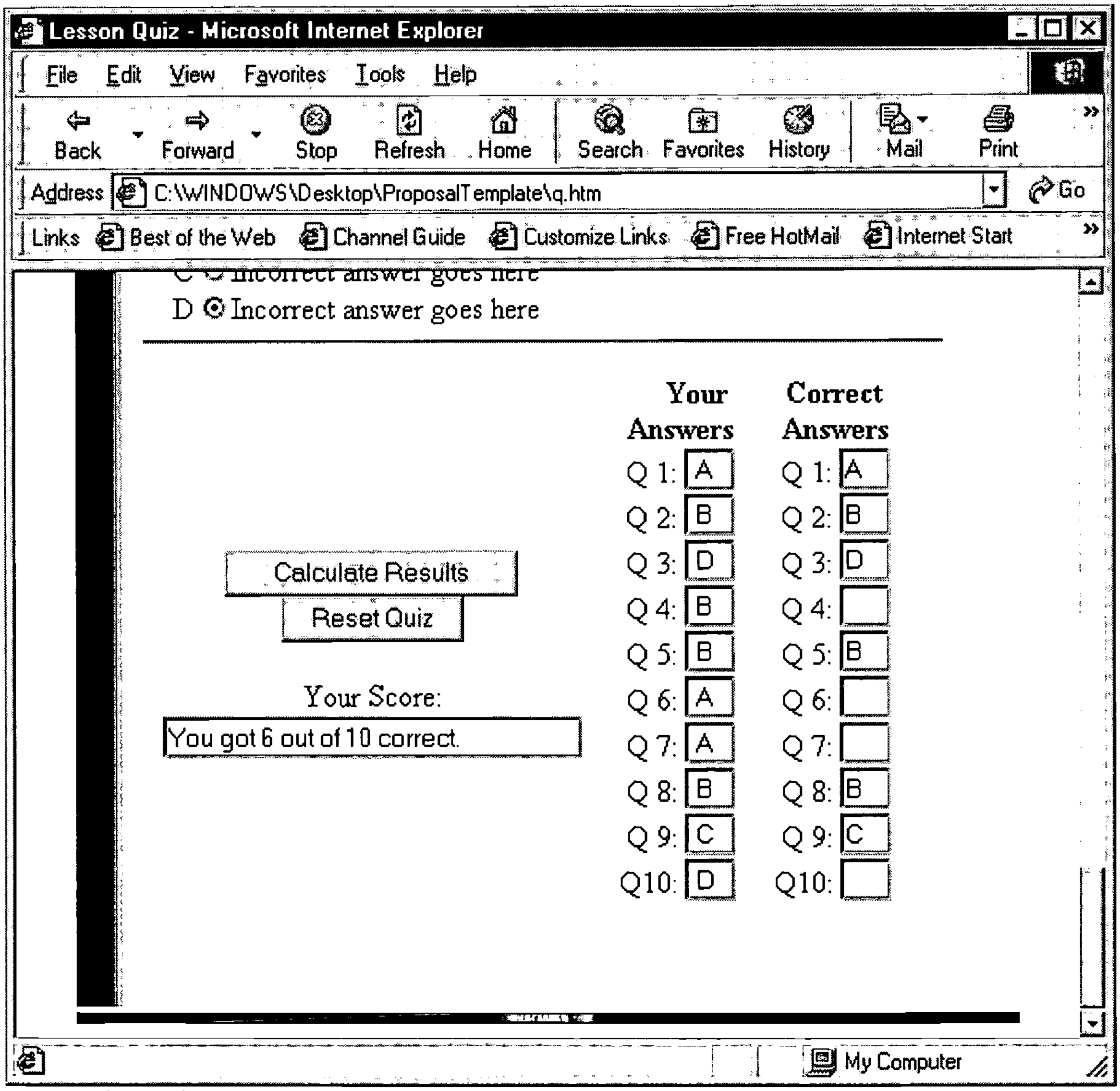

Figure 2. Screen Capture of Performance Feedback section of the Quiz Page

Conclusions

This study examined the efficiency (time and effort), effectiveness (inclusion of specific instructional components and functionality of specific technical components), and appeal (anxiety, confidence, liking, usefulness and intended future use) of two lesson developmental alternatives (WE only and WE + T-N-T) by pre-service teachers. Statistical analysis of six hypotheses confirmed that developing Web-based lessons using WE + T-N-T was more effective than using WE only. The analysis also revealed that neither developmental alternative was superior in terms of efficiency or appeal.

Using a tool such a T-N-T significantly reduces the requirements for technical expertise in the development of a Web-based lesson. T-N-T also provides scaffolding for the creation of pedagogically sound instructional environments by focusing attention of the designer on instructional strategies and methodologies.

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Professor Ann De Vaney and A Good Conversation

Randall G. Nichols
University of Akron

Introduction

The first time I met Professor Ann De Vaney (Becker), she listened well to a paper I presented at a conference. She listened attentively, and doing so is one of the very best qualities of a good academic. So, when given the chance to review her work and write a paper for this symposium, I wondered if this quality of active or good listening is somehow present in her written works. And if something like good listening is evident, how does it manifest itself? So I acquired written works from throughout her career, starting with her dissertation and ending with an end-of-the 20th century work.

My goal is not primarily to examine De Vaney's intended ideas so much as it is simply to see what her writing generally reveals in terms of something like good listening. I don't want to take the works solely at face value but to look into them to see if I can find her paying close attention to people—to research subjects, to subjects otherwise addressed in the works, even perhaps to readers of her works. So, I gathered and read the ten works listed below. They were available from my own library, from ERIC, and from Dissertation Abstracts.

The Works

- *Verbal Ability and Visual Verbal Modes of Presentation in the Acquisition of a Poetic Concept (1974)*
- "A Model for Critical Dialogue: A Study for Enhancing Student Response to Visuals" (1982, with Robert, Roberto, Muffoletto)
- "Reader Theories, Cognitive Theories and Educational Media Research" (1985)
- "Rules of Evidence" (1990)
- "A Grammar of Educational Television" (1991)
- "Square One Television and Gender" (1991, with Alejandra Elenes)
- "Reading Educational Computer Programs" (1993)
- "Introduction: Background to Channel One" (1994)
- "Voices of the Founders: Early Discourses in Educational Technology" (1996, with Rebecca Butler)
- "Can and Need Educational Technology Become a Postmodern Enterprise?" (1998)

Method

At first, I wanted to see if, in her written works, professor De Vaney "listens" to people as well as she had listened to me at the annual Meeting of the Association of Educational Communications and Technology in 1986. Of course, I knew that a typical or literal meaning for "listen" was not good enough; I was *reading* her work. After casting about for the concept that best means the quality I was investigating, and after considering "hearing," "listening," and various communication models, I decided simply to look for instances when, in writing, she appears to attend to people's interests in some way. Attending to another person is what we do in a good face-to-face conversation. We pay attention to people and respond based, partly anyway, on their interests, intentions, needs, and so on.

This line of thinking led me to try to understand her work by asking a rather straightforward set of questions. I wanted to start by first simply asking what each work is about, but early on, I realized that the questions being devised were emanating from the kinds of post-structural, reader, and reception theories Ann uses in her work. She (1985) says, "Meaning can only be understood as what the individual intends. It is, therefore, the individual's intentions which produce the specific relations of differences or similarities..." (p. 10). So, I ask not only what a piece is about but what she means and/or intends. Why is she writing about something? This question necessitates examining the way in which she proceeds with her work--her methodology.

Professor De Vaney says (1985), too, that in post-structural theory we need to be aware that, in discourse, certain audiences are included and "space for certain viewers [audiences], is excluded" (p. 11). So, I ask about whom, in terms of her apparent audiences, she includes and/or excludes.

Further, people and knowledge are continually changing. As De Vaney says (1985), "knowledge accrues" (p. 3). So I look for what, if anything, changes in her writing over time and in terms of the foregoing quest

So, I attempt to address each work by asking basic questions:

1. What is the work about, and what are her (and any co-author's) intent and methodology?

2. Who is her audience, and how does she attend to the interests of those she addresses?
3. What changes in her work and in her attention to people's interests?

Analysis of the Works

Please note that Professor De Vaney has co-authors on three of the works examined here. So, in the case of those three works, the reader should not assume that what emerges or what I say is totally attributable to Ann. Of course, a reader shouldn't assume that anyway, given what we are about to learn from Ann's work.

• *Verbal Ability and Visual Verbal Modes of Presentation in the Acquisition of a Poetic Concept (Becker, Ann De Vaney, 1974)*

1. What is the work about, and what are her intent and methodology?

This first work is Professor De Vaney's dissertation. She writes that, "The main objective of this study was to determine interaction between verbal aptitude and visual-verbal modes of presentation in the teaching of a concept" (p. 3) so as to help media designers and teachers.

The concept is "poetic metaphor," and the modes of presentation are: printed verbal, printed verbal with still pictures, spoken verbal, and spoken verbal with still pictures. She also is interested in the interaction of these modes with subjects' verbal aptitudes. Measures were taken on two dependent variables, comprehension and learning retention.

She concludes that, "one strong result emerged. The sound/still picture treatment (that is, the slide tape presentation) was superior to print, print/still pictures, and sound" (p. 70) "especially for low verbal ability students" (p. 71).

2. Who is her audience, and how does she attend to the interests of those she addresses?

Her audience clearly is primarily her dissertation committee. Academics/researchers, instructional designers, and teachers are a primary, intended audience. Learners are included but only as research subjects and not directly as an audience. Research subjects and readers are treated reasonably. That is, she writes in an expository (empirical, logical, rational) style.

She studies the verbal abilities of people, which implies attending to or listening to people. She works closely with people in terms of learning and communicative ability (print verbal ability).

The study is experimental and quantitative, which indicates that it is less attentive to the subjects. Given the writing style, the audience and subjects are held at arm's length, so their best interests probably are not being served as well as they might.

3. What changes in her work and in her attention to people's interests over time?

Of course, this is the first work studied, so nothing has changed. It is a typical, rational, empirical, expository, third person study and writing from the 1970s. It is what is or was expected in a dissertation.

• "A Model for Critical Dialogue: A Study for Enhancing Student Response to Visuals" (with Robert Muffoletto, 1982)

1. What is the work about, and what are her (and any co-author's) intent and methodology?

The authors try "to explore the effectiveness of a pedagogic strategy which involved the development of descriptive tactics and individual exploration into the meanings and significance of photographic images. It was hoped that the study would reveal methods which enhanced student responses toward photographs, their production, function and value in educational and cultutral [sic] settings" (p. 3).

Students took photos and discussed them, guided by categories provided by De Vaney and Muffoletto: judgment, formal or visual, poetic, and political. Each week for six weeks, students were shown a different Diane Arbus' photo. After the first and last showings and without discussion, each student wrote responses about the photos. Student replies were used to form perceptual categories.

"The results of the study revealed a number of interesting considerations for teachers of media. The study suggested that by structuring the psychological learning environment conceptual shifts could occur. It also suggested that conceptualization in one activity could be crossed over to another activity which becomes an important consideration for educators when using media in their curriculum. The study also suggested that the development of a critical dialogue model for students might enhance verbal responses to photographs" (p. 8).

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work directly addresses attendees of the Annual Meeting of the Association for Educational Communications and Technology: educational technology researchers, media specialists, graduate students, and so on. Other education researchers, academics, and teachers generally are a less direct audience. Again, students are subjects of the study and, in the usual tradition, are not directly addressed as an audience or as potential users of the results of the study. All study subjects and direct or potential audience members are treated quite reasonably. As is usually the case with academic reports, a certain rhetorical distance from the reader and student/subject is present.

Given that Ann is interested in enhancing student conceptual responses to photographs, students are treated as capable learners, thinkers, and conversationalists.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. Compared to the first work, Dr. De Vaney pays greater attention to university students and to how they conceive of and think about photographs. She works directly with them to help them be more thoughtful. She expects learners to be more critical, in the sense that they are rational. However, she does not write directly *for* or *to* students. The work is about them.

• "Reader Theories, Cognitive Theories and Educational Media Research" (1985)

1. What is the work about, and what are her intent and methodology?

This paper is, in part, an exposition of theories that have conventionally guided research in educational/instructional technology. The paper also argues that the professional field should shift to structural and/or post-structural theories and investigations, especially in that structuralism "focuses on human acts...that involve cultural construction and the ways that speech acts involve sentences" (p. 3). Structuralism is interested in the meaning one intends to convey, and "knowledge accrues by perception of meaning, not by information processing...the relationship between the observer and the observed becomes primary. Knowledge...resides in the relationships which people construct and then perceive" (p. 3). "Meaning or understanding is generated by the learner not controlled by the technology or its designer" (p. 6). Post-structural theories go farther, emphasizing viewers and their construction of meaning, and "meaning can only be understood as what the individual intends" (p. 10).

She asks, "How would the learner [reader, student, colleague, writer] be perceived in post structural studies? Essentially, he/she would be understood as the subject...of the meaning, since he/she creates meaning from the text or media presentation...the learner is viewed as a social person belonging to a group, not as an individual person whose brain is the unit" (p. 10). So group construction of knowledge is studied. Conversely, messages may be encoded so that "space for certain viewers, is excluded. Yet, these exclusions may not be obvious to the designer. It is the viewer who has to tell us" (p. 11).

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work directly addresses attendees of the Annual Meeting of the Association for Educational Communications and Technology, though education and educational technology researchers, academics, theorists, and designers (and perhaps teachers) are likely to be a secondary audience, given the venue for the publication. Given that the piece is written in a mostly conventional academic fashion, the audience is treated reasonably. Here, too, learners are never directly an audience for her work, though we can surmise that learners are meant to be the ultimate receivers of the results of her work.

Even though the work is somewhat distanced from learners, Ann's meaningful attention to them is evident in this paper. After all, she views the learner "as a social person belonging to a group, not as an individual person whose brain is the unit."

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. Because of whom she is addressing directly, she is attending again to the learner at a distance, but she writes as though learners have agency and voice and importance.

Here, Ann has left the realm of empirical/quantitative research and immerses herself in naturalistic investigations in education. But she goes beyond the mundane versions of most forms of so-called naturalistic inquiry and begins to show attraction to what I know as critical theory, which is concerned, at its best anyway, with the likes of human freedom, dignity, and social standing.

• "Rules of Evidence" (1990)

1. What is the work about, and what are her intent and methodology?

Ann writes that, "I will discuss whether the establishment of rules of evidence is possible or even necessary. An alternative framing of the question about rules of evidence is, 'How do researchers and practitioners in a specific field know what they know?' I will describe the concept of evidence in law and science. Specifically, I will show that the adoption of statistics as evidence in educational research was historically a clear misreading of the 'scientific method'" (p. 8).

She argues that education, as with the social science of law, is based in context and language and, so, cannot be value free and mechanistic. Instead, law and education research are activities in which evidence is collected and judged inductively not deductively. She goes beyond now common objections to applying many parts of the scientific process to educational research to point out that, like science, "educational researchers are attempting to describe and measure capricious, discontinuous and not easily controlled experiences" (p. 16).

Among other conclusions, she says that, "the conception of science and scientific rigor which dominates the area of educational research, and which was borrowed from the field of psychology, is overly constrained by the adoption of narrow methods and limited use of the mathematics of probability" (p. 17). She wants readers to expand our understanding of educational research.

2. Who is her audience, and how does she attend to the interests of those she addresses?

Ann writes directly for educational technology researchers who try to expand their understandings of educational technology and for scholars of diverse backgrounds, interests, and disciplines. Readers are treated reasonably. Again, students are not a direct audience.

She attends to the best interests of research participants generally by arguing for a research approach that is more inclusive of and context-bound to people's lives.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. The writing style is the same expository/academic form used previously.

To the extent that she wants researchers to be more inclusive and contextual, she is closer to readers and research participants. For the first time, a bit of affect appears—when she says readers should remain "oppositional" not only in terms of conventional educational research but (she implies) in all education work. The argument to broaden research paradigms is much like the last piece reviewed here, though this piece is even more basic in that it gets at a philosophic/rational basis for post-structural research.

• "A Grammar of Educational Television" (1991)

1. What is the work about, and what are her intent and methodology?

This piece explains a way of analyzing how students read educational television and make meaning from it. The theory section of the chapter "borrows concepts from semiotics and suggests a grammatical analysis of television. Such an analysis would describe units of television construction such as frame, shot and sequence, along syntagmatic as well as paradigmatic lines" (p. 255). "In conjunction with syntactical analysis which examines the actual relationships among the categories of construction, paradigmatic analysis...would provide a description of the potential relationships between and among the units of television construction" (p. 256). She then shows how semiotics has been "the most thorough and promising description of the language of media" (p. 257) and applies the description to TV, ETV, and ITV.

She then proposes a model for the method, procedures, and data analyses of the grammar of television. A panel of experts views a program several times, generates focus questions, and identifies program formats. Program segments which are part of the format are identified, the experts record segment structures, and then they run a reliability check on these data. Then data are appraised for program segment patterns. Borrowed codes are noted and traced. Social/cultural origins of the codes are traced, and the social/cultural content and meanings are examined.

She wants to give researchers a way to include social/cultural issues when studying instructional media because often researchers have abdicated their responsibility to do so (p. 276).

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work is written for an audience of educational researchers and theorists. She treats readers very reasonably. Here, too, she does not speak directly to students (or to teachers).

Not all Ann's work exemplifies the qualities of good listening/communication that I am looking for. Some work is just expository. This work only very narrowly explicates how students, professors, or other academics do or can communicate/hear one another well! Ann has the teachers' and students' best interest at heart ultimately, but this piece approaches them from a distance.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. "A Grammar of Educational Television" is very theoretical. The goal of thinking through and proposing a model by which educational television might better be understood is very lofty, given that few have suggested such a thing. But of the works reviewed, this is the one in which she is most distant from the people I suspect she is trying most to help or teach, i.e., learners.

• <u>Square One Television</u> and Gender (with Alejandra Elenes. 1991)

1. What is the work about, and what are her (and any co-author's) intent and methodology?

The authors analyze a children's TV program that generally is accepted as positive because it intends to teach what many of us agree is needed--math skills. The authors use a form of post structural reader theory called "reception theory" to understand *SOTV* in terms of sexism and racism.

They describe *SOTV* as "the quintiessential [sic] post modern children's program, since it employs the latest TV technology to create fractured narratives and messages which, in turn, fragment the subject positions of the viewers" (p. 7). Multiple and fast changing formats are used to gain the children's attention about math.

Unfortunately, the children are also being taught, "how a 12- or 13-year-old boy and girl should act, dress and speak in sexual [even pornographic] fashion" (p. 18). Children are taught that people with non-American accents are to be parodied (p. 19). *SOTV* signals a return to racism, albeit a subtler form of racism (p. 20). Children are subjected to this sexism and racism in 20-40 percent of all *SOTV* programs.

2. Who is her audience, and how does she attend to the interests of those she addresses?

This work directly addresses attendees of the Annual Meeting of the Association for Educational Communications and Technology; though any reader would likely get the feeling Ann and Alejandra are primarily talking to the people at the Children's Television Workshop (who produce and design *SOTV*), directing them to change their programming. Ostensibly, though, the piece is written for educational technologists, researchers, and designers. These audiences are treated reasonably, and they are addressed directly and strongly. Ann and Alejandra do not directly address the recipients (children) of this programming that is shot-through with racism and sexism, though we know it is for the children that they are exposing the program biases.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann (and Alejandra) remains concerned with helping and improving the field of educational technology.

This work is a cultural critique, and the authors are able to show us the full range of what children learn from this program. Further, the tone and affect of this piece are bolder than in any work so far. It has a strong, good moral tone because it involves children and it is written with a strength of belief. What is notable, given what I set out to look for in Ann's work, is when she says that her "analysis of *SOTV* is...designed to investigate the way viewers make *sense* of and learn from *Sesame Street* and *SOTV*" (page 10) (emphasis added). The idea of "sense" indicates she wants people, especially children, to understand by more than just rational means. She wants people to understand TV more completely by using a sense of cultural.

• "Reading Educational Computer Programs" (in Muffoletto & Knupfer, 1993)

1. What is the work about, and what are her intent and methodology?

Here, Ann uses reader theory again to look at how a computer program "makes its users a subject of and subjected to particular discourses and their concomitant values and knowledge structures" (p. 181). Reception theory sees knowledge as a social construct, and in doing so, "it can uncover the manner in which cultural messages are enfolded in the rhetoric of...an educational computer program" (p. 182). The theory allows Ann "to consider the relationships among user, program, and producer..." (p. 82). With this theory, Ann sets out to uncover cultural messages in *Where in the World is Carmen San Diego* (*WWCSD*), the computer game.

She concludes that people are diminished by some computer programs because the programs treat them as logical problems-solvers who value immediate feedback, efficiency, and productivity, who are not frustrated by lack of spontaneity and who are mechanized subjects. At the same time computer users are people who must participate in larger social discourses of computing whose participants produce and are embedded in "a range of aesthetic, moral, and political value judgments...produced and regulated by the language of the participants"(p. 183). Critically, she notes that a person in this discourse "may be totally unaware of the constructed nature of these value judgments and may believe them to be natural or self-evident" (p. 183).

Further, *WWCSD* itself

> provides an invitation to users to participate in a rational-logical discourse that is conflated with discourses of sexism and racism. It addresses students of any race or gender in a disrespectful manner. Young girls are not only invited to perceive themselves as objects, but also because this game is sanctioned as an "educational" imprimatur, they are encouraged to believe that this perception is appropriate. Boys fare little better, for the program empowers them in chauvinistic ways which will serve them poorly in their daily lives....People of color are ignored in the old versions and trivialized in the 1991 version. This treatment means that the majority of the California school population is eased out of subjectivity, unless people of color care to participate in a racist discourse" (p. 191).

In order to subvert these conditions, and being able to find only one good example of alternative instructional software, Ann suggests these guidelines:

- place the technology in the hands of subjects of alternative discourses whose rhetoric includes goals of equity and personal freedom
- place the technology in the hands of ethnic groups and allow them to represent their thinking and behavior in an authentic manner
- place the technology in the hands of women for the purposes of creating cooperative software (p. 195).

2. Who is her audience, and how does she attend to the interests of those she addresses?

The audience for this work appears to be educational technologists and academics generally and, perhaps, computer program designers, all of whom she treats reasonably. Those whom the programming is about and for—learners—are treated with respect. Learners themselves, recipients of the critique and anything resulting from it, are not addressed directly. Obviously, though, Ann urges that producers of computer programs should alter their programming so that users are treated as people who not only value efficiency and the like but who also are spontaneous and participate in a larger social context of aesthetics, morals, and judgments. In this fuller treatment, Ann is respectful of learners/users.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. In this piece, she is speaking whole-heartedly about the relations of educational computing and its production of sexism, racism, objectification, over-rationalization. She urges greater self-determination, freedom, and democracy in technology uses, especially for children and women. She is more obviously subversive of biased educational thinking and materials than in any other work so far.

• "Reading the Ads: The Bacchanalian Adolescence" (De Vaney, 1994)

1. What is the work about, and what are her intent and methodology?

Ann uses reader theory again to analyze Channel One ads from 1990 and 1992. She asks, "How do these ads construct their subjects or position their viewers? In other words, just whom do these ads think their viewers are?" (p. 139)

She concludes that the ads borrow from commercial TV forms. They are postmodern in that they feature "fractured narratives, fragmented images, heightened use of jump cuts, excessive use of dancing and singing, and startling juxtaposition of images" (p. 145). The people in the ads are almost totally white, beautiful, and sexual. The ads focus on pleasure, and "no labor is depicted" (p. 146).

She does not want to suggest that teens always use the images in Channel One commercials as guidelines for living, but she does suggest that "if Hollywood and commercial television and classroom TV present only a Bacchanalian adolescence, then these images may assist teens in the construction of adolescence as primarily a party" (p. 147). In these ways, the ads are irresponsible (p. 151).

2. Who is her audience, and how does she attend to the interests of those she addresses?

The primary audience appears to be academics/researchers, though she seems also to writing directly to Chris Whittle and Whittle Communication--or to anyone trying to influence the culture and commerce. She treats the audience reasonably. Partly because of where it appears, in a text available mostly to people in higher education, she is not writing directly to teachers or students. However, we can see in the dedication in whom she is most interested: "With respect and love for the thousands of elementary and secondary students we have taught."

Ironically, if teachers in the primary audience take this piece and/or its ideas to their own students, who are not the primary intended readers, the piece may have more effect than if the commercial interests read it. Students may change, whereas commercial interests aren't.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. She still is trying to change the way media, in this case school/media advertising, produce and/or influence younger learners/viewers/users while ignoring minority groups and women. Though not as strongly, the sense of urgency felt in Square One Television and Gender in this piece, too.

• "Voices of the Founders: Early Discourses in Educational Technology" (with Rebecca P. Butler. In Jonassen, 1996)

1. What is the work about, and what are her (and any co-author's) intent and methodology?

In this work, De Vaney (and Butler) derives meaning from audiotapes and written text of the founders of the field of educational technology. She uses reader theory and neo-theoretical analysis to talk about the voices and texts in the "amorphous field" of educational technology/audiovisual instruction in roughly the first half of the 20th century in America.

She concludes, among other things, that "The rhetoric of the founders and those who follow indicate that the basis of this field will always be hardware, with its concomitant marketplace and governmental interests. If we turn away from this, our voices will remain within the academy. We will be talking to ourselves. Whatever tempering influence we could have had will be lost " (p. 38).

She devotes quite a bit of attention to women in the field, and concludes that "Although women in educational technology became more prominent [in the decades after WWII], the placement of women in this field is still uneven today.... today, women continue working towards equal recognition, opportunity, and responsibility within educational technology" (p. 43).

She speaks directly to a democracy and communication when she points out that the field today "gathered a berth in the academy with the discourses represented in World War II research, operant conditioning, and military training...Perhaps the audiovisual educators...noted the efficiency and effectiveness of military pedagogy operating particularly in the service of democracy, and where convinced that education should proceed down the same road" (p. 38).

She hears the people involved in the formation of the field and speaks of the ups and downs *of the valorization of humanistic discourses* and *democracy* and *the common person* associated the field of educational technology. She allows the voices of the founders to be heard. She speaks of the human condition and "One of the things that was valued in WWII was the preservation of democracy, and many projects were conflated with that desire. Unfortunately, the methods for accomplishing that preservation at that moment in time were undemocratic, i.e., hierarchical and militaristic" (p. 38). She also notes that democratic ideas of the founders included a "model of action" (p. 38) whereby they got all sorts of work *done*.

2. Who is her audience, and how does she attend to the interests of those she addresses?

This piece is directly for researchers, faculty, and students in educational technology. Ann favors women in these groups getting more prominence in the field and working toward more recognition, opportunity, and responsibility. She literally listens quite closely—and well--to the founders. Readers and audiences are treated reasonably and respectfully. In this work, she and Becky Butler give others voice by writing about others and by speaking for women, founders, democracy, freedom, and equality.

Though we know Ann cares about them, here too, she does not directly speak to students.

3. What changes in her work and in her attention to people's interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology and the places of women and minorities. In terms of its methodology, attention to women in the field, and relations to societal-cultural issues, this is an unusual history of the field. Readers can see the importance of connections with politics, hardware, and prior economic issues. She displays a great deal of fairness toward "fathers" in the field of educational technology; she realizes the culture in which the founders existed and how that affected them and the profession.

• "Can and Need Educational Technology Become a Postmodern Enterprise?" (1998)

1. What is the work about, and what are her intent and methodology?

This piece takes a pointed look at historical, hegemonic features of educational philosophy: "European [sic] and Americans writing about democracy also voiced their values and views of humans while calling for equality for everyone. Yet, their epistemological assumptions sketched the human as a rational/logical entity that actually reflected the person of European male. Thinking they were acultural, as educational psychologists and technologists thought they were acultural, these writers called for equality for the white male.... The postmodern critique of subjectivity uncovers this fallacy" (p. 78). De Vaney describes the development of educational technology as a modern project, with its belief in progress, profits, patriotism, machines, and human equity. So, educational technologists often have exhibited a lack of caring about gender, power, race, and human equity. Effects of modernity in education include the commodification of students and, at best, an interesting construction of subjectivity. Learners became classroom capital to be sold to commercial enterprises. Learners became mental models stripped of social and cultural dimensions; notions of human diversity were constrained.

Today, many people in the field of educational technology resist the unavoidable changes brought on by a postmodern position. Postmodernists study race, gender, ethnicity, and power relations. They are skeptics who often attack/deconstruct modernity and the beliefs in which educational technology is embedded. They often deconstruct by examining discourse. Teachers/technologists are unaware of the ways in which their discourses are not only created by them but enslave them to narrow views of human diversity.

However, Ann says, "postmodern discussions of subjectivity allow teachers to discern how students are constructed by instructional media and software" (p. 77). She says that,

> Alternatively, videos and software must not only picture girls and children of color but also provide respectful representations of diverse groups. If in a video a credible Muslim boy is presented with respect and given agency, there would then be room for the formation of a new subjectivity in the classroom. Knowledge about subjectivity allows teachers to resist subtly stereotypic constructions as well as to recognize when equitable representations and those with agency come along (p. 77).

She is interested in resisting the commodification of students and the capitalization of classrooms. Postmodernist positions help teachers to resist. She is interested in respect for people.

2. Who is her audience, and how does she attend to the interests of those she addresses?

She speaks directly to the readers of Theory Into Practice. The readership includes teachers and teacher educators. These audiences are treated reasonably. She also treats readers as people with agency, as she encourages them to resist problematic discourses/media. She listens and speaks to teachers and tries to help them. She respects them in this discourse. Once more, she does not speak directly to students, though we know that ultimately it is they as well as their teachers for whom she is writing.

3. What changes in her work and in her attention to peoples' interests over time?

The topic is different, though Ann remains concerned with helping and improving the field of educational technology. In the greatest detail so far, she addresses distinctions between modern and postmodern and how they relate to cultural considerations in education, educational media, classroom practices, teachers, and formation of student subjectivities. She is interested in resisting the objectifying and commodifying of students so that they may develop greater agency and self. She notes again that resistance is needed—resistance by teachers and, one suspects, resistance by students.

Results

The following general answers to the guiding questions emerge from the analysis of the ten written works studied.

1. What is the work about, and what are her intent and methodology?

Dr. De Vaney writes about ten different topics in the field of educational technology, topics which include aptitude-treatment-interaction and media, teaching critical responses to photographs, a field shift to post-structural and reader reception theories, rules that constitute knowing in the field, how to read the structures of educational television, sexism and racism in ETV programming, the diminishing of children by TV programs, degradation of the subject by TV ads, a post-structural history reading of the field and the struggle by women in that field, and the need for a postmodern philosophy of educational technology. In general, the work is about laudable goals: human education, equality, and voice.

She often uses her writing to improve and/or defend the lives of learners. She intends to teach those in educational technology that they/we should be interested in more culturally relevant forms of work that may resist the diminishing of learners that older forms often promote. She is especially concerned with improving the lives of women and minorities. She wants to subvert the conventional paradigms of educational technology field. She wants to make our work more supportive of democracy.

Her research methodology broadens quickly in her career to sociological/cultural models of research. In most of her works, she uses qualitative, post-structural (often, reader reception theory), and inductive forms to examine the topics. She uses expository writing to report her findings. I mean "expository" to be the use of precise and logical written statements and explanations.

2. Who is her audience, and how does she attend to the interests of those she addresses?

In many of the works examined here, the primary audience is AECT convention goers: researchers, professors, graduate students, and perhaps some school media specialists. Otherwise, her audience is educational technology researchers, theorists, and academics generally. She speaks to women and minorities related to these fields. She speaks to Chris Whittle of Channel One and the Edison Project and to designers and producers at Children's Television Workshop and SOTV. Only occasionally do teachers appear to be the intended audience. She virtually never directly addresses students in her work—except as participants in studies.

All readers are treated reasonably and respectfully—even those who would use technology to diminish learners. Even when her writing approaches ire toward these diminishers, she is reasonable and respectful. Most significantly from the point of view of communicating/listening/responding, Ann's work strives (though indirectly in some cases) to give people (researchers, women, teachers, students, readers generally) greater voice, agency, and knowledge. She is dedicated to gaining greater voice, freedom, democracy, and respect for many people.

3. What changes in her work and in her attention to peoples' interests over time?

Of course, the specific topics of her works change from writing to writing, though they stay within the field of educational technology. After a very short time, her work is more foundational and philosophic in that it seeks wisdom as it deals with very basic issues. The pieces get stronger--especially when she talks about youngsters--and address democracy, freedom, respect, and voice. The work is somewhat more subversive over time; it asks readers to resist convention and change the cultural makeup of the field.

Discussion

Ironically, to well and fully carry out an investigation such as the present one, I should have given her more voice; I should have spoken directly with Dr. De Vaney about these questions and issues. As she says, "Meaning or understanding is generated by the learner not controlled by the technology [written word] or its designer" (p. 6).

In terms of the listening I have been looking for, Ann's writing is sometimes a very collaborative process in which she works directly with other authors (e.g., Muffelotto, Elenes, and Butler, herein). To this basic extent, she communicates well.

But from within her work, too, she carries on a conversation or, to use her language, a "discourse" with many people. Discourse is not a concept constrained to oral or even written language. As De Vaney and Butler (1996) say, "We consider discourses...to be texts 'writ large'(p. 5) "...discourses are invisible systems of thought" (p. 5).

It is clear in her works that Ann respectful and careful of learners; I refer you to the dedication she makes in Watching Channel One: *With respect and love for the thousands of elementary and secondary students we have taught.* This is evidence that she is concerned with learners' best interests and that, in this way, she is carrying on a good discourse with them.

Her discourses with students and educational technology broaden and deepen over time; at least if we look at the first and last works studied here. The dissertation is very empirical and rather narrowly focused, but the last piece, "Can and Need Educational Technology Become a Postmodern Enterprise?" is sweeping in scope and concerned with very basic issues of human education.

Ann's work encourages the possibility of school democracy and, therefore, I believe, true school reform. Remember, she says,

- place the technology in the hands of subjects of alternative discourses whose rhetoric includes goals of equity and personal freedom
- place the technology in the hands of ethnic groups and allow them to represent their thinking and behavior in an authentic manner
- place the technology in the hands of women for the purposes of creating cooperative software (1993, p. 195).

This concern with democracy and local control of technology is evidence of her attending to and having good discourse with people. It is also unusual in that, as far as I can see, virtually no democratic schooling takes place in America.

Her work attempts to be fair, which is an attribute I would claim is essential for good discourse. In her attention to and sensibilities for helping children, women, and minorities, she cannot be accused of being unfair to males—as is evidenced by her treatment of the founders who may have made some questionable choices when they invested in technology, given its bent toward the undemocratic (De Vaney and Butler, 1996).

With this concern for what democracy can and should be, Ann keeps a sense of a good future in mind without negating or forgetting the past. This, among other attributes, makes her writing moral, which is another attribute of good discourse/conversation.

Her work is a reliable, valid analysis of educational technology in one form or another, as evidenced partly by her successful career and, mostly, by her own "rules of evidence."

So, the quality of attending to my thoughts that I first noticed in Ann is present in her written work, too. However, I do not want to give the impression that I agree with everything she says. For example, I am not sure that too many postmodernists and modernists are too polemical, as she says in "Can and Need Educational Technology Become a Postmodern Enterprise?" Sometimes an argumentative appeal can bring democracy more quickly than a more purely reasonable appeal.

My only major question about her scholarship is that she virtually never directly speaks to the students (and sometimes the teachers) for whom she writes! If Ann were a better communicator, wouldn't she also have spoken or written directly to learners more than she has? Wouldn't she have used a more direct, inclusive assessment of people's comprehension of poetic metaphor or teachers' need to resist commodification?

Conclusion

Those of us in educational technology would do well to consider following the paths she has gone down, be they her research topics, methodologies, and philosophies; be they the people about whom she is interested; or be they the ethical stance she takes.

I will say that examining her work has made me realize that I virtually never do my work directly *for* students—which now seems to me to be a very serious error. Writing for and speaking to academics--including

teachers, principals, media specialists, and professors—is not likely to do any good for students in schools. Of course almost no one writes or speaks for learners. But I know of almost no professors who write directly to students of any age to encourage them to work toward self-voice, agency, democracy or even learning! Maybe we should write books (or whatever) for students so that they will understand and make decisions about educational technology for themselves instead of being told what to do all the time!

It is clear that in her written work Ann is doing well at working toward understanding how people communicate, how they make meaning with one another. However, throughout this paper I have been uncertain about what I mean by Ann's ability to listen or communicate. My shifting use of terms indicates my uncertainty. Perhaps I can be clearest if I tell you that my examination of her written work leads me to conclude, mostly, that Ann is very good at carrying on the kind of good conversation Jane Roland Martin describes:

> A good conversation is neither a fight nor a contest. Circular in form, cooperative in manner, and constructive in intent, it is an interchange of ideas by those who see themselves not as adversaries but as human beings come together to talk and listen and learn from one another.

People have a lot to learn from Ann.

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Faculty Point Of View Of A Faculty Development Program

H. Ferhan Odabasi
Coskun Bayrak
Anadolu University, Turkey

Background

The importance of professional development of teachers in higher education has been a rising issue in the recent years. In fact the developments in education reveal that so much as the knowledge reflected, the higher education instutions should be learning organizations themselves, as well (Latchem and Lockwood, 1998). Being professional as a higher education teacher involves a knowledge base in both the subject or dicipline area and in education, thus all higher education teachers must learn to create a synthesis between their knowledge of their discipline and how students learn (Beaty, 1998). Professional development activities, in HE realized to improve teaching, enhance student learning and facilitate faculty research and other scholar activities, ty to over come this "double professionalism" (Beaty, 1998). Anadolu University in Turkey, which carries the unique distance education in HE in the country and known as a pioneer institution in many different areas, started a program called "Educating the Educators" in 1999. The program is aimed to assist the faculty to enhance their teaching skills. Conscious of that many of the faculty have had no or little experience in teaching skills, the university wanted to start the program with a general teacher education program approach.

The Purpose And Methodology Of The Study

This study was carried out in Anadolu University, Turkey. The population of the study consisted of 78 full time faculty as assistant professors.

Table 1 Population of the Study

Gender	f	%
Female	38	49
Male	40	51
Field of Study		
Social Sciences	37	47
Applied Sciences	16	21
Fine Arts	7	9
Technical Sciences	6	8
Health Sciences	7	9
Communication Arts	5	6
Adult Learning Experience		
Yes	21	27
No	57	73

The questionnaire used in the study was designed so as to get the necessary responses for the evaluation of the program.

The questionnaire consisted of three parts. The first part elicited the personal information The second part consisted of questions to evaluate the given courses and the last, third tried to elicit suggestions about how the future programs should be designed.

The purpose of the study was to learn the opinions of the faculty about a faculty development program carried out and their suggestions for a future program.

Results

Since the results of the first part of the questionnaire are summarized in Table 1, only the second and third parts will be discussed here.

Evaluation of the Courses by the Participants
Altogether there were nine courses offered in the program. The participants were asked to evaluate the courses as from the point of view of nine criteria as;

- Efficient use of time
- Satisfactory content
- Applicability of the knowledge presented
- Level of meeting the needs
- Encouraging participation
- Solving teaching problems
- Clearity of the subject
- Enviromental Appropriateness
- Sufficient practice and case studies

The analysis of the results revealed that the courses ranked, as from the most productive to the least, as follows ;

1. Faculty-Student Relations
2. Characteristics of the Adolesence
3. Use of Technological Resources
4. Educational Technology
5. Class Management
6. Academic Counsellig
7. Instructional Methods and Strategies
8. Planning the Instruction
9. Evaluating the Instruction

Faculty's Suggestions for a Future Program
In the third part of the questionnaire the participants were first asked to name the courses that should take part in a future program and the results were as follows;

COURSES	f
Effective Speaking &Listening	62
Use of Technological Resources	62
Faculty & Student Relations	60
Academic Counselling	60
Effective Presentation	60
Characterictics of Adolesence	55
Educational Technology	53
Academic Progress	49
Evaluating the Instruction	48
Class Management	47
Academic Regulations	32
Instructional Methods &Strategies	29
Organization and Administration of University	27
Creative Drama	23
Planning the Instruction	23

The second item of the third part of the questionnaire asked the priorities that a future program should carry and the results were as follows;

PRIORITIES OF A FACULTY DEVELOPMENT PROGRAM	f
Needs Analysis	26
Efficient Curriculum	23

Voluntary Participation	18
Effective Timing	11
Classification According to Area of Study	10
Informing the Participants Beforehand	8
Small Group Interaction	4

Conclusion

The results of the study revealed how the faculty who attented the program evaluated the program and made suggestions about a future program. The results of the evaluation of the courses showed that the faculty mostly found the Faculty-Student Relations course to be most beneficial. However Planning & Evaluating The Instruction courses which are more teaching skill oriented came at last. This might be a clue that the faculty rather need courses that support teaching but not right in the middle of it. This fact is also revealed in the faculty's course suggestions for a future program. Here the faculty suggest Effective Speaking & Listening; Faculty & Student Relations and Academic Counselling Courses in the highest rank for future programs

When it comes to the priorities that a future program should carry; the faculty reveal that a Needs Analysis is the top priority. Then comes the Efficient Curriculum. This result shows the weakness of the program.

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Sixth Graders' Motivation During Problem-Based Learning

Susan Pedersen
Texas A&M University

Abstract

This study employed a mixed methods design to examine students' motivation during PBL, comparing it to their motivation during typical class activities. Analysis of the quantitative data shows that students demonstrate more intrinsically motivated behavior during PBL than during their regular class activities. The qualitative data suggest that the greater opportunity for collaboration and student control over class activities afforded by PBL may partially account for students' enhanced motivation.

The literature on intrinsic motivation enumerates the many ways it can benefit learning. Intrinsically motivated students persist in the face of failure, undertake challenging aspects of a task, show creativity, and remain cognitively engaged in tasks longer than their extrinsically motivated peers (Ormrod, 1995). Given these conditions, it is no wonder that interest in learning for its own sake has been shown to be positively correlated with achievement (Alexander & Murphy, 1998; Schiefele, 1996).

How do we account for variations in motivational orientation? Research conducted within a developmental framework (e.g. Harter, 1978) cast intrinsic versus extrinsic orientation as a property of the individual, an enduring characteristic that is shaped over time by successes and failures (Schunk, 2000). Similarly, models that have arisen out of a cognitive framework have primarily examined learners' perceptions and beliefs, tacitly defining motivational orientation as a product of the covert thought processes of the individual (Bong, 1996). In both cases the effect of situational variables on motivation has largely been overlooked.

Recent theories of motivation have taken a different view, using a "learner in context" approach in the study of motivation. In their theory of situated motivation, Paris and Turner (1995) have postulated that motivation, like cognition, is situated. They argue that an individual's motivational beliefs and behaviors are derived from contextual transactions. From this perspective, motivation is necessarily unstable, varying with each context because the context itself causes variations in learners' perceptions and goals.

This interest in the role of context has led researchers to examine the types of approaches and the conditions within learning environments that can encourage learners to assume an intrinsic motivational orientation to learning. One approach that holds promise is problem-based learning (PBL). In PBL, all learning occurs as a result of students' efforts to solve a complex problem. Instruction begins with the presentation of the problem; as students grapple with the problem, they realize that they lack information and skills that they need to develop a solution. Students then engage in self-directed study to meet these learning needs. As a result, activity is largely under student control and learning is meaningful because students are the ones who have generated a need for it.

PBL is widely regarded as highly motivating to students. Barrows and Tamblyn (1980) suggest that students are motivated in PBL by the internal rewards of learning, and not by grades or external rewards. Hmelo and Ferrari (1997) point out that PBL calls for an action on the part of the student (the development of a solution) and that students are often more motivated by the pragmatic goals involved in knowledge building for action then in knowledge building for its own sake. To the extent that students see the relevance of the problems used during PBL to their own lives, this approach may tap into personal interest. This is certainly the case in medical education where students are typically challenged to deal with the same types of situations they will encounter in their chosen profession.

Research findings suggest that PBL may help to promote an intrinsic motivational orientation in students. Moore-West, Harrington, Mennin, Kaufman, and Skipper (1989) found that PBL students gave higher ratings of their experience than non-PBL students on a variety of topics, including meaningfulness, emotional climate, and student interactions. Medical students enrolled in PBL programs found their education more relevant to their future careers than their traditional track peers (West, Umbland, & Lucero, 1985). PBL students were more likely to describe their preclinical program as difficult, engaging, and useful, while non-PBL students were more likely to describe theirs as irrelevant, passive, and boring (Albanese & Mitchell, 1993). In a longitudinal study of the effects of a course taught entirely through PBL, graduates were asked during telephone interviews about favorite courses, and about the course that was most helpful in teaching them problem finding, problem solving, critical thinking, and ethical decision making. Students overwhelmingly favored the class taught exclusively through PBL on all of these questions (Stepien, Gallagher, and Workman, 1993).

Taken together, these findings suggest that students enjoy the challenge of PBL, that they find topics more interesting when they encounter them through PBL, and that they feel this approach leads to more profound learning than other approaches. In this way, PBL may enhance learners' motivation, encouraging them to behave in a more intrinsically motivated manner than they do during the teacher-centered learning activities they typically encounter in school.

The theory of situated motivation may help to account for why students find PBL environments motivating. Paris and Turner (1995) identify four characteristics of contexts that may support an intrinsic orientation in learners, all of which are incorporated in PBL environments. The first, *choice*, implies the ability to choose among alternative courses of action, and reflects the personal interest of the individual. Learners who are free to choose the activity that they find most interesting and productive are more likely to be thoughtfully engaged in a task and show persistence and self-regulation. PBL environments provide some constraints for choosing (students must do work that contributes to a solution plan) yet they are rich enough to permit multiple paths through the problem space. As learners identify possible courses of action, they are free to pursue those they want, and may change course as they think best. The second characteristic, *challenge*, contributes to motivation by encouraging risk-taking, and successful performance on challenging tasks enhances the individual's cognitive self-assessments of their competence and efficacy. The problems used in PBL are selected because they are both challenging and manageable for students. *Control* has been shown to promote motivation by increasing learner interest, confidence, and sense of self-worth. The extended periods of self-directed study and the level of autonomy students enjoy during PBL offer them a high degree of control over their learning activities. Finally, *collaboration* impacts motivation in several ways. Their peers' statements and interests may stimulate learners' interests, encouraging them to pursue information they had previously overlooked. Students may be more likely to try out certain activities when their peers have modeled it, and peer modeling may offer students a means by which to monitor their own level of accomplishment. Collaboration may also foster a sense of responsibility to others that motivates learners to persist and perform up to their potential. PBL's use of collaboration therefore can be seen as supporting both student construction of knowledge and motivation.

Paris and Turner's theory of situated motivation has another implication for the examination of motivation. They stress that motivation is neither a characteristic of the learner or a property of an event, but rather the result of the interaction of the two. From this perspective, a learner's motivational orientation in a given situation should be the product of both his or her enduring motivational beliefs and the impact of the features of that situation on those beliefs. If motivation is a product of a learner by context interaction, then a difference in motivational orientation should be accompanied by a correlation between motivational levels in different environments. This correlation would be the result of some degree of stability in learners' motivational orientations. For example, a group of learners may express a greater preference for challenge under some conditions than others, but learners who generally prefer challenge should rate preference for challenge more highly in all situations than students who generally prefer easy work.

Purpose of the Study

The purpose of this study was threefold. First, this study sought to expand the literature on problem-based learning by examining its impact on the motivational orientation of middle school students. PBL has been used extensively with mature learners (medical school, graduate programs) and the gifted. However, only limited information on its effectiveness with younger, regular education learners has appeared in research literature.

Second, PBL's potential impact on motivation makes it a prime candidate through which to test the implication of Paris and Turner's theory that motivation is the product of a learner by context interaction. Evidence supporting this theory would show that learners differ by context in their motivational orientation, but that their scores in different contexts are correlated. This correlation would indicate the role that the enduring characteristics of learners play in motivation, while differences in scores could be attributed to contextual factors.

Finally, using the theory of situated motivation as a starting point, this study also sought to begin an investigation into the aspects of PBL environments that may help to enhance motivation. By examining reactions to the learning environment used in this study, it may be possible to discern some of the characteristics of PBL that enhance student motivation.

Three research questions were posed:

1. Do learners report different levels of intrinsic motivation for regular science class environments and this PBL environment?
2. Do the levels of intrinsic motivation students show for regular science class predict the levels they show for this PBL environment?
3. What aspects of this PBL environment enhance student motivation?

Method

Participants

Students in three intact sixth grade science classes at a suburban middle school in the southwestern United States participated in the study, with N=66. The same teacher taught all three classes. The scores of four students were discarded. One of these students transferred out of the school before the completion of the study. Three other students possessed limited English proficiency, and normally received a modified curriculum. The classroom teacher and an ESL teacher worked extensively with these students, often directing their work. Because students' ownership of the problem solving process is a key feature of PBL environments and this feature may contribute to the positive impact PBL has on learners' motivation, this level of teacher directiveness might have interfered with the treatment. Data from these three participants were discarded because they may not accurately reflect the impact of PBL on motivation.

The ethnic makeup of the classes reflected the school at large. 77% of the participants were Caucasian, 15% were Hispanic, 5% were African American, and 3% were Asian. The classes were split almost evenly by gender, with two more girls than boys participating in the study.

Treatment Variable

All participants completed the activities in *Alien Rescue,* a hypermedia delivered problem-based learning environment for use in sixth grade science classes. The science fiction premise of this program places students in the role of young scientists aboard a newly operational international space station where they are part of a worldwide effort to rescue alien life forms. To accomplish this goal, students learn about the planets and large moons of our solar system by searching existing databases and designing probes to gather additional information. While the primary learning objectives of *Alien Rescue* focus on astronomy and space travel, the program offers ties to other areas of the curriculum, including life science and mathematics. All information needed to solve the problem is contained within the virtual environment created by the program, though it is structured in such a way as to not suggest its usefulness or lead students toward a particular solution. The program normally takes fifteen forty-five minute periods to complete.

Data Sources

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom (Harter, 1981) was administered both before and after students participated in using the software program. During the pretest, students were asked to think about their experiences in their regular science classes up to that point. During the posttest, they were asked to reflect on their experiences with *Alien Rescue* and imagine participating in similar projects in the future. The purpose of changing the instructions was to determine if students express different levels of intrinsic motivation in the two different settings.

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom comprises five subscales, though only four were used in this study. Table 1 lists the subscales used and provides information about each. The scale uses a structured alternative format. Learners are presented with two "types" of kids, then asked to decide which type they more closely resemble. Once they have chosen the type, students must then decide if that choice is "really true for me" or "sort of true for me." Items are scored on a 4-point scale, with 1 representing the maximum extrinsic orientation and 4 representing the maximum intrinsic orientation.

Table 1: Subscales in the Scale of Intrinsic versus Extrinsic Orientation in the Classroom

Subscale	Description	Sample Statement	Subscale Reliability
Preference for Challenge vs. Preference for Easy Work assigned	Does the student like hard, challenging work or prefer easier assignments?	Some kids like difficult problems because they enjoy trying to figure them out, but other kids don't like to figure out difficult problems.	.78 to .84
Curiosity/Interest vs. Pleasing the Teacher/Getting Good Grades	Does the student work to satisfy his or her own interest, or to satisfy the teacher and obtain good grades?	Some kids read things because they are interested in the subject but other kids read things because the teacher wants them to.	.68 to .82
Independent Mastery vs. Dependence on the Teacher	Does the child prefer to do his/her own work and figure out problems on his or her own, or does the child rely on the teacher for help and guidance in these areas?	If some kids get stuck on a problem they ask the teacher for help but other kids keep trying to figure out the problem on their own.	.70 to .78
Independent Judgment vs. Reliance on the Teacher's Judgment	Does the child feel he/she is capable of making judgments about what to do, or does he or she depend on the teacher's opinion about what to do?	Some kids think it's best if they decide when to work on each school subject but other kids think that the teacher is the best one to decide when to work on things.	.75 to .83

Interviews

Brief interviews with students were conducted at the end of the unit, after students had completed the attitude questionnaire. The purpose of these interviews was to gather additional data about learners' opinions of learning in the *Alien Rescue* environment and possible reasons this environment encourages intrinsic motivation.

Students were interviewed in groups of two and three. These interviews were partially structured. Seven core questions were asked of all interviewees, then other questions were added to encourage students to elaborate on the opinions they expressed. The core questions were

What did you think of *Alien Rescue*?
What did you like most about *Alien Rescue*?
Do you think you learned any science during *Alien Rescue*?
Did you feel you had control over what you did during *Alien Rescue*? Did you like that? Would you have liked *Alien Rescue* as much if you hadn't?
How did you feel about working with your classmates? Did it help?
Did you find the problem challenging?
Would you want to do programs like *Alien Rescue* in the future?

Procedures

The study was conducted during students' regular science class times, which were daily 45-minute periods. Students were engaged in the program for approximately thirteen class periods, with an additional four class periods used for introductions, data-collection, and a debriefing session.

Each student worked at his or her own computer. Students were encouraged to work together to share the information they discovered and to ask each other for help. They were not, however, assigned partners or told they had to divide up the work in any way. Daily whole class meetings were held at the beginning of the period so that

students could share their findings and questions, model their processes, and discuss their strategies for developing a solution. The researcher facilitated these discussions, but did not direct student activity.

The Scale of Intrinsic versus Extrinsic Orientation in the Classroom was administered on the first day and the fifteenth day of the study; because of the way the days of the study fell, administrations were exactly three weeks apart. Interviews were conducted in the last two days of the study.

Data Analysis

Students' pre and post treatment scores on the Harter Scale of Intrinsic versus Extrinsic Orientation in the Classroom were used to address the first two research questions. For the first research question, "Do learners report different levels of intrinsic motivation for regular science class environments and this environment?" the data were analyzed using a repeated measures analysis of variance with one repeated variable (pre/post). To answer the second research question, "Do the levels of intrinsic motivation students show for regular science class predict the levels they show for this PBL environment?" a regression analysis was conducted, with the posttest scores as the dependent variable and the pretest scores as the independent variable. The resulting R squared was used to determine if a significant portion of learners' scores on the posttest could be predicted by their pretest scores. In this way, it was possible to reflect on how much of learners' motivational patterns represent enduring characteristics of the learners, and how much of that variance is attributable to other factors including the type of environment.

The interviews conducted with learners at the conclusion of the study were transcribed and analyzed using a two-level scheme following the guidelines provided by Miles and Huberman (1994). The data were examined for insights into the causes for enhanced motivational orientation. At the first level, codes were generated using the four characteristics suggested by the theory of situated motivation (choice, challenge, control, and collaboration) and by multiple passes through the data. At the second level, these codes were regrouped into more general categories. The data were sorted into categories and subcategories according to their common themes. Data were analyzed by two reviewers and disagreements between them were discussed until a .9 interrater reliability was established.

Results

Quantitative Data

The pre and post test scores of the participants were compared to determine if learners expressed different levels of intrinsic motivation for their regular science class environments and the PBL environment offered in programs like *Alien Rescue*. Results of the repeated measures analysis showed that students' scores on the posttests were significantly higher than on the pretest for all four subscales, as shown in Table 2. In other words, students reported a significantly more intrinsic orientation for the *Alien Rescue* environment than for their typical class activities.

Table 2: Mean Scores and Standard Deviations (in Parentheses) by Treatment Condition on Subscales of the Scale of Intrinsic versus Extrinsic Orientation in the Classroom

Subscale	Pre Treatment Means and SD	Post Treatment Means and SD	F	*p*
Challenge	2.58 (.77)	2.94 (.58)	21.5	<.01
Curiosity	2.53 (.95)	2.79 (.48)	5.1	<.05
Mastery	2.65 (.69)	2.90 (.51)	13.40	<.001
Judgment	2.61 (.63)	2.84 (.57)	12.47	<.001

To answer the second research question, a regression analysis was conducted to determine if students' pre treatment scores predicted their post treatment scores, and if so, to calculate the amount of variance in the post treatment scores that could be explained by enduring characteristics of the learners. The results are shown in Table 3. In three of the subscales, learners' scores on the pre and post treatment administrations showed a significant correlation. In the challenge subscale, 39% of the variance in the posttest could be explained by students' scores on

the pretest. For the mastery and judgment subscales, these figures are 37% and 36% respectively. These results suggest that there are enduring motivational characteristics of students that help to account for the level of intrinsic motivation they report for novel learning environments like the one offered in *Alien Rescue*.

Table 3: Regression Analysis of Pre and Posttests on Subscales of the Scale of Intrinsic versus Extrinsic Orientation in the Classroom

Subscale	t	R squared
Challenge	6.44**	.39
Curiosity	1.22	-
Mastery	6.18**	.37
Judgment	6.00**	.36

**significant at $p < .01$

Qualitative Data

The qualitative data were examined in order to gain a more robust understanding of students' opinions of the Alien Rescue environment, and how these opinions influenced their level of intrinsic motivation. Four themes were chosen prior to the interviews through an examination of the theory of situated motivation. These themes were choice, challenge, control, and collaboration. Three other themes emerged from the analysis. They were perceived educational value, computer delivery, and novelty.

Choice

All of the students interviewed indicated that they would like to work on other problems like the one presented in *Alien Rescue*. When asked if they would want to do programs like this all the time, students' responses ranged from "Not really all the time, but once in a while" to "most of the time" and "Yeah, like everyday after school I run home and get on the computer." A few students added stipulations about how they would like to work, with one student saying he would only want to do programs like this at school, not at home. Another student commented, "I'd rather do it more often if it was with a group than by myself. Like if Alien Rescue was for sale and I bought it, I would want to have three computers and do it with some friends."

Challenge

Most of the students interviewed said that they felt *Alien Rescue* was challenging, but not overly so, that "it wasn't too hard, it wasn't too easy." When asked how they liked being challenged, students responded positively. "Yeah, it was pretty complicated. I like that. I like complicated things." One student described it as "fun challenging."

A few students noted that their classes rarely presented them with situations as challenging as the one in *Alien Rescue*. One student explained why he felt *Alien Rescue* was better at encouraging him to tackle challenges than typical school activities:

> This is just like using my own steps. If I can solve it that way I would try to, instead of teachers always telling you the right way and I always end up taking the easy road instead of at least trying to do something different.

Control

All of the students interviewed felt that they had control over their actions during *Alien Rescue*, and liked this aspect of the program. When asked if they would have liked to have more direction from the teacher, most students gave a resounding "No," and said that the program would not have been as much fun if the teacher had taken more control over their activities. One student explained,

> Cause if you want to make a probe you want to make a probe. If you want to do research, you do research. But it wouldn't be much fun if you had to make a probe or you had to do research.

The fact that students had control over their own process meant that different students were working on different aspects of the problem simultaneously. One student saw this as supportive of collaboration and a distribution of labor: "if everyone's doing the same thing you can't find different things out."

Two students commented that this level of control set *Alien Rescue* apart from typical school activities:

At first we didn't know what to do so we just looked around, but it was real fun to do it by ourselves, cause during regular classes all you have to do all year is the teacher telling you what to do, but she said we could do what we wanted to do, so it was what we supposed to be doing. It was really fun cause we got to choose what we were going to do.

Probably one of the things I liked the best about it is you always have a teacher telling you how to do something, but since you're trying to find the problem and trying to solve it, you get to solve it your own way, not the way that the teacher wants you to do it.

Collaboration

Students in all three treatment conditions said that they felt *Alien Rescue* provided them with ample opportunities to collaborate with their classmates, and that they both gave and received help. Several students cited collaboration as one of their favorite aspects of *Alien Rescue*. Comments included "It made it fun and challenging at the same time," "The funnest part was working around with a whole bunch of people" and "I liked it cause it just made us come together more and learn thinking skills together."

The opportunity to collaborate led to a division of labor for many students, and there were several comments that this helped them to work more quickly. One student explained, "We just started splitting up planets, working on the same things, saying 'What's your hypothesis so far?' You can cover more space with two people, more than one." Another student explained how this sharing of responsibilities worked for himself and two of his peers:

Me, this other guy (I forgot his name) and Andey, we worked together. It's like I'm here, he's there, and he's there, and we were working together. I would go to the solar system and I would look up planets for them and he would look at the aliens and he would say if the planet would work and he would say, "Okay, it needs this much atmosphere." And I would look for a planet with that much atmosphere but like with no earthquakes.

Collaboration also led students to challenge each other's ideas, making it possible to avoid mistakes and make better decisions than they would working alone:

Yeah, and you could find out their hypotheses about that, and you could say "Well, that's not my hypothesis, so how did you come up with that?" and then they can tell you stuff that you didn't really know. You could compare the hypotheses. Like if I didn't have a piece of information that he did, then I would just send them to a totally wrong planet.

One impediment to collaboration was discussed by a group of students. Many of the students did not know each other well, and in some cases did not even know their classmates' names. Sixth grade is the first grade of middle school, and this study was conducted in November. Ten weeks of school had been insufficient for students to become acquainted, and some students did not feel comfortable talking to peers they did not know. Three students who had collaborated extensively explained that they worked together because they had gone to the same elementary school and had been friends for several years. In contrast, they did not work with another student seated next to them: "Like Jason, he sits on the other side of me, and was hard for me to get started to communicate with him because I didn't know him." Another student commented that before *Alien Rescue* she had not known the classmate seated next to her very well, but that during the course of the program they had become "very close" because of their collaborative efforts.

Several students commented that they rarely had the opportunity to collaborate in their regular classes, and when asked, all of these students said they preferred to work together as they had during *Alien Rescue*. Most said that it made learning more fun. One student explained that the freedom of movement students had during *Alien Rescue* meant less reliance on the teacher: "Sometimes we're sitting next to someone and they don't know the answer, and I can't just get up and ask someone, so I always just have to resort to a teacher. I don't really like to do that sometimes."

Perceived Educational Value

Students generally felt they learned a great deal from their experience with *Alien Rescue*. When asked what they felt they had learned, most students identified specific scientific facts about the solar system and the design of probes, as well as concepts like why some worlds have magnetic field.

In addition to learning science content, a few students talked about developing problem-solving skills. Two students remarked,

> It teaches you a lot about how to make steps and about the scientific method. If you just skip around and not go step by step it will usually come out wrong and you won't get all the information you need.
>
> Yeah, and how you went through a lot of steps. First you have to do research, then you make a hypothesis, then check it, and if it was wrong you have to go over it again and study all the aliens and the solar system and everything that they need to live in.

Several students said they felt like *Alien Rescue* gave them the opportunity to work like scientists, identifying hypotheses, deciding how to gather the information they needed, and collaborating with their peers. One student commented,

> Normally like in movies and stuff you think of scientists, how they talk together, they actually come together in meetings and announce everything they learned. And we did that before every class period. Really and we could get up out of our seats, so actually it does feel like scientists.

Computers

Two other themes emerged from the data that suggest factors other than the characteristics of PBL may have contributed to the more intrinsic orientation students expressed for the *Alien Rescue* environment. The first is the impact of computers in general or this computer-based program in particular. The interactive nature of computers themselves may encourage students to explore, taking a mastery orientation and enjoying the challenge of figuring out the functionality of a program. Several students commented that their textbooks were often boring, and that being able to work on the computer and collaborate with their friends was more fun.

Some features of *Alien Rescue* may also encourage students to take an intrinsic orientation. While PBL encourages exploration by giving students the responsibility for generating learning needs and finding the resources to meet those needs, this software may also encourage exploration through the use of rich media and a science fiction premise. When asked what they liked best about the program, most students responded by citing their favorite feature of the program or commenting on the problem itself, not by describing aspects of the way they worked. Describing the alien computer component of the program, which contains QTVR movies of the aliens and their habitats, one student commented, "It was kinda cool when you could just look at all the aliens, and turn them around and everything. Then you could look at their habitats and their solar system." In describing the problem, another student said, "I thought the whole idea of the aliens coming and us having to find a place for them and being able to be on their computer is pretty neat." Several students also described the program as a game. One student explained, "I think of it as a game because it's on computers," indicating that both the program and its delivery medium may suggest play. Rieber (1996) suggests that by its very nature play is intrinsically motivating; learners' motivational orientation may have therefore been enhanced simply because they felt they were able to spend three weeks of science class playing.

Novelty

The second theme that emerged from the data has to do with the impact that the novelty of this environment may have on students' motivational orientation. In addition to pointing out how *Alien Rescue* differed from their regular class activities within the other themes, students' comments showed that they enjoyed the change in routine that their work on this program represented. Comments such as "I've never done something like that, " "I liked getting away from class for a while, " "It's better than working in a book," and "We don't usually get to use computers," show that, for students, one positive aspect of this program was simply that it was different from regular classes. One student explained that typical class activities are of limited duration, and that he like the prolonged investigation offered by the software: "It was for an extended amount of time, not just one day, so when you go in the next day and you can say 'Oh, where was I? Oh, yeah, I've got to get information from the probe.' I liked that." Some comments suggest that students found their work in this environment less intimidating than in their regular

classes: "It was easier, it was fun, cause you usually don't get to talk in class. Be quiet and if you don't be quiet you get a detention. But we were allowed to talk." And "We get an automatic 100 everyday instead of getting like 70s and stuff." The lack of extrinsic motivators, such as punishment and grades, may have freed students to adopt a more intrinsic orientation than they do in their regular classes.

Discussion

The findings of this study strengthen the growing literature on the effectiveness of problem-based learning in two ways. First, it shows that PBL can encourage intrinsically motivated behavior. Second, these results were achieved with regular education sixth graders, suggesting that PBL should be used with a wider audience than has been the case in the past.

These findings also lend support for the notion of the situated nature of motivation. Students' scores on the post treatment administration of the Scale of Intrinsic versus Extrinsic Orientation in the Classroom were correlated with their pre treatment scores, indicating that there are enduring motivational characteristics of learners that affect how they react to different learning environments. At the same time, the significant difference between the scores on the two administrations of this scale indicate that some environments are inherently more motivating than others. Taken together, these findings support the argument that motivation is a product of a person by context interaction.

Why do students report a more intrinsic orientation for an environment like the one posed by *Alien Rescue* than for their regular class environments? The qualitative data suggest that challenge, control, and collaboration, as Paris and Turner suggest, impact motivation positively. A PBL approach may also foster the perception in students that they are learning valuable problem-solving skills and working as scientists; seeing the value in their activities may enhance motivation, as widely suggested in the literature on motivation. However, other factors may partially account for the high level of intrinsic motivation students reported. Students used the computer lab everyday for three weeks, which they had never before done as part of a class. Unfettered by concerns over grades or detentions, students may have felt more willing to take risks and enjoy the challenging nature of the tasks involved in developing a solution plan. The interactive nature and rich media of the computer program may have promoted a sense of play and curiosity. These factors, as well as the sheer novelty of the approach and the software, may have encouraged students to react with greater intrinsic motivation than they do in their regular science classes. Certainly they suggest a need for a closer investigation of the attributes of this environment as well as the environments created by other PBL programs to determine which contextual factors unite to support an intrinsic orientation.

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Formative Research on the Heuristic Task Analysis

Charles M. Reigeluth
Ji-Yeon Lee
Bruce Peterson
Michael Chavez
Indiana University

Abstract

Corporate and educational settings increasingly require decision-making, problem-solving and other complex cognitive skills to handle ill-structured, or heuristic, tasks, but the growing need for heuristic task expertise has outpaced the refinement of task analysis methods for heuristic expertise. The Heuristic Task Analysis Method was applied to three settings to generate improvements and more detailed guidance, and to identify variations in the method for different situations. The three settings were group counseling, tutoring on writing skills, and selecting artwork for a product line. The formative research methodology was used to test the method and generate improvements. The three studies produced some common and some unique findings and recommendations. A tentative revision to the HTA method is proposed.

Introduction

As our society in general and the workplace in particular become more complex, we are finding that a greater number of the activities that people undertake are relatively more heuristic in nature than ever before. Whether in K-12 education, higher education, corporate training, or any other context, to help people learn the heuristic elements of an expert's know-how, we must be able to identify those heuristics.

In analyzing heuristics, we find it helpful to think in terms of two major kinds of expertise—domain and task expertise. *Task expertise* relates to the learner becoming an expert in a specific task, such as managing a project, selling a product, or writing an annual plan. *Domain expertise* relates to the learner becoming an expert in a body of subject matter not tied to any specific task, such as economics, electronics, or physics (but often relevant to many tasks). (Reigeluth, 1999, p. 435).

Both procedural and declarative knowledge are important elements of both kinds of expertise. In this research, we focus on task expertise. For task expertise, we find it helpful to think in terms of two major kinds of tasks: procedural and heuristic. *Procedural tasks* are "tasks for which experts use a set of steps, mental and/or physical, to decide what to do when, such as a high school course on mathematics or a corporate training program on installing a piece of equipment for a customer. *Heuristic tasks* are "tasks for which experts use causal models—interrelated sets of principles and/or guidelines—to decide what to do when, such as a high school course on thinking skills or a corporate training program on management skills." (Reigeluth, 1999, p. 435).

The distinction between procedural and heuristic tasks is similar to the distinction between well structured and ill structured domains (Fredericksen, 1984; Resnick, 1988; Simon, 1973). In reality most tasks are neither purely procedural nor purely heuristic, but some combination of the two. We have relatively powerful methodologies for analyzing the expertise that underlies procedural tasks (i.e. the mental and physical steps upon which an expert relies). But we do not have good methodologies for analyzing the expertise that underlies heuristic tasks. This situation is exacerbated by the reality that heuristic knowledge is frequently tacit rather than explicit—that is, experts are often unaware of the heuristics that guide their performance. Therefore, there is a strong need to develop task analysis methodologies for identifying the knowledge that underlies heuristic tasks. The full paper reviews literature related to heuristic task analysis. Then it describes three research studies that have been conducted to improve one of those methodologies. This paper is a summary of the full paper.

The Heuristic Task Analysis Method of Elaboration Theory

The Elaboration Theory (Reigeluth, 1999; in press) offers the Heuristic Task Analysis (HTA) method as part of its Simplifying Conditions Method (SCM) for task analysis. This more general method of task analysis is conducted by asking the question, "What is the simplest version of the task that an expert has ever performed?" and "What is the next simplest version?" and so forth. As each version is identified, its place in the learning sequence is simultaneously determined. Therefore, the SCM task analysis method is an integral part of the method for designing an instructional sequence. Furthermore, since most tasks have a combination of procedural and heuristic elements,

the procedural and heuristic task analysis methods are integrated into a single process. For these reasons and because this method offers a fair amount of guidance for the task analysis process, we chose this method for our research. Hence, it is described in greater detail next.

The SCM's Heuristic Task Analysis Method

The following are some details on the SCM's heuristic task analysis method. They are an elaboration of the process described by Reigeluth (1999).

Phase I. Prepare for Analysis and Design

1. **Prepare.** Lay the groundwork for your analysis and design.
   1.1 Establish rapport with a task expert.
   1.2 Explain the analysis process you will be using.
   1.3 Ask the task expert about the nature of the task in general.
   1.4 Identify the characteristics of the learners in general.
   1.5 Identify the delivery constraints of the task in general.

Phase II. Identify the First Learning Episode

2. **Identify the simplest version.** Help the task expert to identify the simplest version of the task that is fairly representative of the task as a whole, and to describe the conditions that distinguish that version from all other versions.
   1. You may want to use some **other criteria** in addition to simple and representative, such as common and safe
   2. Ask the task expert to recall the **simplest case** she or he has ever seen. The simplest version will be a class of similar cases. Then check to see how representative it is of the task as a whole.
   3. It may be helpful to start by identifying some of the **major versions** of the task and the **conditions** that distinguish when one version is appropriate versus another.
   4. Thinking of different conditions helps to identify versions, and thinking of different versions helps to identify conditions. Hence, it is wise to do both simultaneously (or alternately).
   5. There is no single right version to choose as the "simplest." It is usually a matter of trade-offs. The very simplest version of the task is usually not very representative of the task as a whole. The more representative the simple version can be, the better, for it provides a more useful schema to which learners can relate subsequent versions.
   6. It may be wise to go through this process with several task experts before going on to Step 3. You may find it necessary to take steps to resolve differences of opinion about which is the best "simplest version" to use.
3. **Analyze the organizing content.** Analyze the organizing content for this version of the task.
   3.1 Ask the task expert to think of **one specific performance** of the task to analyze, or to videotape a performance for you to review with the expert during the analysis.
   3.2 Use a **top-down approach** to analyzing the content (the knowledge upon which the expert's performance is based). In other words, start by identifying the general categories of knowledge that an expert uses, then proceed to analyze each.
      7. Ask the task expert:
         - to **describe each decision** that the task expert made,
         - to **identify the kinds of knowledge** that the task expert drew upon to make the decision, and
         - to **describe the specific knowledge** within each kind of knowledge that the task expert used.
      8. The kinds of knowledge are likely to include:
         - **steps** (procedural knowledge),
         - **guidelines** or **rules of thumb** (heuristic knowledge),
         - **explanatory models** (which explain why the guidelines work),
         - **descriptive models** (which describe the phenomena with which the task expert interacts), and
         - **metacognitive/decision rules** (which the task expert uses to decide which steps, guidelines, and descriptive knowledge, to use when).
      9. It is generally helpful to start by asking the task expert if there are any **steps** or phases of activities that are always performed for this version of the task. If so, perform a procedural task analysis to identify the sequence of steps and to see if any of those steps can be broken down into substeps, but those substeps must be ones that an expert thinks of and uses routinely in performing that version of the task.
      10. For guidelines, use the following process:
         1. Identify the ***goals*** for this specific performance of the task under its conditions.

2. Identify all the important ***considerations*** for attaining each goal. Considerations are the major categories of causal factors that influence performance of the task. If there are a lot of causal factors for a consideration, it is useful to identify subconsiderations for it.
3. Identify all the important ***causal factors*** for each consideration (or subconsideration).
4. Analyze each causal factor to identify all ***guidelines*** (prescriptive principles or "rules of thumb") that an expert uses to account for this consideration.

11. For explanatory **models**, use the following process:
12. For each guideline, ask the task expert for the reasons why s/he believes it works.
13. For interrelated guidelines, you are likely to identify a set of related reasons that constitute a causal model or models. Be sure to look for multiple causes for each effect and multiple effects for each cause. Also look for chains of causes and effects, and explore probabilities for each causal factor to have each effect.
14. For descriptive **models**, use the following process:
    1. Ask the task expert what phenomena influenced this particular performance of the task. Try to identify all causal relationships that characterized those phenomena. Be sure to look for multiple causes for each effect and multiple effects for each cause. Also look for chains of causes and effects, and explore probabilities for each causal factor to have each effect.
15. For metacognitive/**decision rules**, use the following process:
    1. Find out what rules the task expert used to decide when to use which steps, guidelines, and descriptive models during the specific performance of the task being analyzed.
16. It is wise to query the task expert about any of these kinds of knowledge that are not initially described to you for each decision the task expert made in this specific performance of the task.

3.3 Ask the task expert to think of similar **performances** of the task that constitute a single version of the task. Use each such performance to broaden the steps, guidelines, explanatory models, descriptive models, and metacognitive/decision rules so that they represent the knowledge bases the task expert uses to deal with all performances for that version of the task.

3.4 If time and resources permit, find a second task expert with whom to repeat this entire process (Steps 1–3.3) to identify any alternative views of the task and the knowledge that underlies its performance. It may even be wise to repeat this process with several more task experts. And you may want to go back and ask each task expert what s/he thinks about the perspectives of the other task experts, in an effort to reconcile conflicts and select among alternative ways of thinking about and performing the task.

The HTA method has not been rigorously tested and therefore is in need of further research. However, the most important research issue is not the validity of the HTA method, for, like most methods, it is likely to work some times but not always, and to varying degrees. Rather, given the immaturity of our knowledge about how to analyze heuristic tasks, what is needed most at this point is developmental research—research that is intended to further develop and improve the method. Therefore, our research question is, "In what ways can the HTA method possibly be improved?" To answer this question, it is also necessary to find out what parts of the method are working well and what parts are not working so well. Furthermore, to improve the HTA method, it will likely be important (1) to change parts of the method, (2) to provide more detailed guidance about how to accomplish particular parts of the method, and (3) to identify variations in the method for different situations, such as different kinds of tasks or even different kinds of task experts.

To answer these research questions, we conducted a series of three developmental research studies. These are described next, followed by some general conclusions.

Study 1: The HTA Method Applied to Group Counseling

The purpose of this study was to improve the HTA method and guidance for use of that method. Thus, the formative research methodology was adopted with emphasis on exploring how the HTA method can be improved when applied to group counseling.

Formative research is a kind of developmental research or action research that is intended to improve design theory (Reigeluth & Frick, 1999). In contrast to research on descriptive theory, which emphasizes validity or how well the description matches the reality of "what is," research on design theory is more concerned with preferability, the extent to which one method is better than other methods for achieving certain goals under certain circumstances. By creating or identifying an instance of a design theory and collecting formative data to improve

that instance, one may develop better understanding of how the theory works in the field and thus be able to propose improvements for the theory, which of course would need to undergo further testing.

Task. Group counseling was selected as the task to which to apply the HTA method. Group counseling is a combination task with both procedural and heuristic elements. It is procedural in that the activities of the group leader are largely determined by the stages that a group goes through (i.e., forming, norming, storming, and performing), and the leader cannot help the group to progress to the next stage without performing certain tasks (steps) at each stage. However, at a deeper level of analysis, the knowledge required for the leader to decide when and how to intervene is not a set of steps but a set of guidelines and principles, which are heuristic knowledge.

Participants. This study involved three participants as task experts in group counseling. Expert #1 was a professor in the Counseling Department in the Indiana University School of Education and was the most experienced of the three task experts. The other two were doctoral students in the same department. They were all experienced in conducting "personal growth" group counseling, and their expertise ranged from three to more than 20 years.

Data Collection Methods

Interview. Semi-structured in-person interviews were used as the primary data collection method. The second author conducted six interviews between September and November, 1999. Each interview took 30-90 minutes and was audio taped for analysis. The purpose of the interviews was to find ways to improve the HTA method for eliciting, analyzing, and representing the expert's heuristic knowledge for performing the task of "personal growth" group counseling. The investigator played two roles, one as a task analyst proficient in the HTA method and the other as researcher searching for ways to improve the HTA method. As task analyst, the investigator developed a set of interview questions (see Appendix A) for the interview based on the HTA method, but as researcher the investigator was not restricted to the predefined questions. Depending on the expert's response, the researcher revised the HTA method for the next interview. Thus, the overall interview process was flexible and reflective in nature.

Videotapes. Because of the confidential nature of group counseling, direct observation or videotaping of an expert's task performance (as called for by the HTA method) was not allowed. Instead, the researcher (as analyst) used a series of instructional videos that simulated group counseling sessions for beginning group leaders, to provide the analysts with a concrete case.

Data Analysis and Interpretation Methods

The HTA method is an iterative process: finishing the first round of HTA is not the end of the study but the beginning of the second round of HTA; and the end of the second round is, again, the beginning of the third round; and so on. The investigator went through two rounds of HTA in this study.

Triangulation. To enhance the thoroughness of the data, this study involved three experts as data sources. Each of them played somewhat different roles during the interviews. During each round of data collection, expert #2 provided the initial structure of the task setting and knowledge base. Then experts #1 and #3 reviewed the knowledge elements, verified them, and provided additional information. There were a few times when the three experts did not agree with one another. In such cases, expert #1's judgment was accepted, as he was the most experienced group counselor.

Member checks. After each interview with an expert, the researcher transcribed the interview and took the summary and interpretations to the next interview for review. Through this process, the experts corrected errors or misconceptions by the researcher, and the researcher asked additional questions to clarify the information.

Consultation. During the data collection and analysis process, the researcher regularly met with the other three researchers in this study and consulted them in designing the interview protocol and analyzing the data.

Results and Discussion

The first round of data collection involved initial interviews with three experts. Instead of finishing with one expert and then starting with another, the researcher worked with the three experts simultaneously (but separately) due to their time schedules. This approach involved some tradeoffs. It worked well in the sense that the researcher could get the three experts to reach consensus on the simplest version of the task early in the HTA process. However, communicating with all three experts simultaneously was not easy for the researcher, and the researcher had to spend most of the time during the interviews explaining to each expert the previous interviews with other experts. Even though the task was a common one, the experts still had difficulty explaining the detailed decision-making process when the task had originally been defined by another expert. Facing this problem, the

researcher decided to use an existing instructional video series (with which all three experts were familiar) as a frame of reference, instead of trying to build a new scenario based on each expert's experience.

The second problem was that the researcher lacked expertise in the task of group counseling. The researcher found that, to be able to push the expert to further elaborate his/her automatized (and hence subconscious) task expertise, the analyst needed to speak the same language as the expert and be able to prompt when the expert had difficulty in finding the right words. Without a certain level of expertise in the task, the researcher as task analyst had difficulty doing those jobs smoothly.

The third problem was related to the difficulty of categorizing the types of knowledge underlying each decision made by the expert during the task analysis. The purpose of identifying the five types of knowledge identified by the HTA was to make sure that the expert did not overlook one of the important types of knowledge, but the benefits of distinguishing among the types seemed to not be worth the extra time required in this case.

The second round of HTA incorporated some new methods to deal with the problems found in the first round. First, the researcher summarized key incidents from the video series on index cards and used them as a reference during the interviews with the experts. This was very helpful in three ways: (1) it helped the experts to recall details about the task performance process, (2) it helped both analyst and experts to see the flow of the task performance process and get back on track when the experts got off-task, and (3) it saved a lot of time in revisiting previous points. One expert commented that the index cards forced him to be more precise during the review and revision process. Second, the researcher as analyst used a bottom-up approach (identifying knowledge first, then categorizing it as to type) rather than the top-down approach (identifying knowledge within each type) suggested by the HTA method.

Based on the findings of this study, the following changes are proposed as possible improvements and described in detail below: (1) incorporate various interview and observation techniques into the HTA process, (2) provide different guidelines for analysts with different levels of task expertise, (3) provide different guidelines for working with task experts with different levels of expertise, and (4) provide reference material during the interview with task experts.

Study 2 - The HTA Method Applied to Tutoring on Writing Skills

As in Study 1, the purpose of this study was to improve Reigeluth's HTA process by using the formative research methodology. This study followed the steps suggested by Reigeluth and Frick outlined in study 1.

Task. The heuristic task chosen for this study was tutoring university undergraduate students who needed extra assistance with their writing skills. Specifically, the task concerned the decision-making process in which an expert writing tutor engages to determine the direction and focus of the tutoring session. By its very nature, a tutoring session requires a lot of heuristic expertise, because it is determined more by events that occur during the tutoring event than by any predetermined procedural steps. What occurs during the tutoring session depends on both the writing situation and the tutee. The writing situation includes why the tutee is being tutored, the relationship between the tutee and the teacher, the interest level of the topic being written about, and the number of drafts already written. The tutee includes any previous experiences, both positive and negative, that the tutee brings to the tutoring session.

Participants. Two experts were chosen based on their level of expertise and the approval of their supervisors. Both experts had extensive experience tutoring all levels of writing students, and both were highly recommended by their writing center supervisors. A third tutor was also recommended and interviewed as a potential participant in this study. However, the recommendation came without the experience and evaluation credentials listed above, so he was not included in this study.

Data Collection Methods

Interview: As in study 1, the main data gathering method was the personal interview, and the researcher both elicited heuristic knowledge (analyst role) and conducted formative research (researcher role). Two interviews were conducted within one week of the tutoring session that was being analyzed. Both of the interviews were conducted within one week of the tutoring session that was being analyzed. Because of the tutors' lack of time to spend on this research, each interview was limited to approximately 60 minutes. Prior to the interviews, each of the tutors was sent emails describing terms used, definitions, an outline of the interview questions, and a brief explanation, written in their terms, of the purpose, expected results, and use of this research.

Before the actual interview, the researcher reminded each tutor of what was sent to them earlier and asked if any terms or points needed to be clarified. At this time, the researcher also pointed out to each expert writing tutor that a) it was unclear whether the task about to be analyzed was actually based on heuristic knowledge and b) it was

unclear whether the questions would be able to access that knowledge. This was done to reduce any anxiety that the writing tutors might experience if they could not produce information that the researcher desired.

Based on the first interview, the HTA methodology was altered slightly for the second interview so as to assist the tutor to better recall the tutoring situation. The analyst had the tutor respond to specific questions about the actual tutoring experience, the tutee's characteristics, and the tutee's essay prior to having the tutor recall and reflect on her decision-making processes. He then had the tutor identify the decision areas to focus on during the tutoring session. Afterwards, he had the tutor choose the concern that was most available to her. This, then, became the subject of the heuristic task analysis.

Data Analysis and Interpretation Methods

There were no follow-up interviews or member checks as in Study 1 to determine the validity of the tutors' responses due to the writing tutors' lack of time to spend on these tasks. However, because of the researcher's expertise in this area, he concluded that the data collected was not spurious. At the conclusion of each interview, the experts were asked to review and modify what was recorded during the interview. The researcher asked each expert for ways to improve the interview process and to comment on its effectiveness in eliciting the knowledge underlying their decision-making thought process. Both offered suggestions about ways to help them recall the previous tutoring situation and about the limitation of focusing on only one aspect of the tutoring process. The second expert confirmed what the first had concluded. After each interview, tentative changes were made to the HTA process.

Results and Discussion

In the interview after the first application of the HTA method, the first tutor mentioned how the process helped him think about his own tutoring strategies. He also mentioned that having to recall from memory a tutoring session that was done even within the last seven days was not easy. The tutor suggested the following refinements to the HTA method. 1) The top-down process seemed effective. 2) Because the tutor experienced some difficulty recalling the specific tutoring session, the analyst (researcher) asked some specific questions about the tutee, the paper, and the tutee's reactions to the tutor's suggestions. Both tutors said this helped them get into the flow of the previous tutoring session, and the researcher observed a marked increase in awareness and confidence after assisting the tutor's recall. 3) 5x8 cards were effective in that the tutor referred back to them to align his insights into the tutoring process with previous statements. 4) The tutor, when identifying the guidelines, focused more on how to hold an effective tutoring session than on what influenced his decision to focus on a specific tutoring objective. In addition, 5) the researcher suspected that the results of the HTA might have been richer if the task expert (tutor) had been given more control over the decision point selection process.

In summary, an important concern involves the task expert's tendency, when explicating the guidelines, to focus on the goals and not on the decision points for attaining the goals. During both instantiations, the writing tutors gave the guidelines they used for deciding on the goals of the tutoring situation rather than giving guidelines for deciding how to attain a goal during the tutoring session. When this occurred, the researcher gently prodded the experts to focus on the decision points rather than the goals. However, when the experts could not provide that information, the researcher decided to review previous sections and then ask that question again. After the experts referred to the goals again, the researcher decided not to push them any further, seeing that they both were unable to provide that information. Another concern involves the first expert's difficulty in recalling the tutoring session despite the fact that the session occurred only one week prior to the interview. Measures taken to assist the second expert's ability to recall the tutoring session showed a dramatic improvement.

Study 3: Selecting Artwork for a Commercial Product Line

The third study tested the HTA method in a corporate setting. As in the previous two studies, formative research was the methodology, using a designed case to generate possible improvements in the HTA method. Corporate executives want a "big bang for their buck," and analysis is often looked upon as a time-consuming activity with questionable impact. The aim of this study was to develop a rapid, high-impact version of the HTA method for corporate settings. Thus, the study was designed to provide insight into the following research questions: (1) How can the speed and effectiveness of the HTA method be improved for eliciting, analyzing, and representing heuristic knowledge from experts in corporate settings? (2) What guidance could be added to the method to assist analysts in corporate settings? The time constraints for this study dictated that the research be limited to a single interview cycle with one task expert, lasting no more than a total of three to four hours.

Task. The heuristic task chosen for this study was deciding whether a submission of artwork was suitable for one of the company's product lines. This was a judgmental decision-making task requiring a fair amount of experience and know-how. The task expert verified that the task was important to the company, that she was

considered to be an expert at the task, and that it was not easy to articulate the expertise required to perform the task. The heuristic nature of this task was verified by an expert in the HTA method.

Participant. The task expert was recruited by calling a local business that had collaborated with the Instructional Systems Technology Department at Indiana University in the past. A manager in the design department enthusiastically agreed to participate in the study. The expert and the analyst discussed possible complex decision-making tasks over the telephone and came to an agreement on an appropriate task.

Data Collection, Analysis, and Interpretation Methods

Interview. The researcher/analyst conducted two audio taped, one-and-a-half-hour interviews with the participant (task expert) in a conference room at the expert's place of business. The analyst/researcher referred to an interview sheet (described below) to ensure that he was adhering to the guidelines of the HTA method, although he also allowed the interview to be somewhat unstructured as seemed appropriate to gather the heuristic knowledge and data for improving the HTA process. After one-and-a-half hours he reached a saturation point in terms of gathering the essence of the task and the key heuristics and concluded he could not effectively continue the analysis without first going back to his office and organizing the information collected. The expert agreed to continue the interview the following week. The analyst/researcher logged "significant chunks" of the audio tape on 3" x 5" cards. His criterion for "significant chunks" was any piece of knowledge that fit into one or more of the types of knowledge listed in the HTA method. He examined these knowledge elements to determine what missing ones he needed to ask about in the follow-up interview. Then in the role of researcher, he re-examined the interview results for deviations from the HTA method to see where the method was effective in eliciting heuristic expertise and where deviations were helpful. He discussed his preliminary findings with Reigeluth and worked with him to plan the second interview.

Results and Discussion

Speed of the HTA method. The analyst/researcher found a number of areas in which the speed of the HTA method might be enhanced. Two are discussed in this section. The others are the result of improving the effectiveness of the method and are discussed in the next section. The analyst/researcher noticed that almost an hour was spent identifying the simplest version of the task and distinguishing it from other possible versions. This can be important for training purposes, as outlined in the SCM methodology. However, in a business context, there can be other purposes for conducting the heuristic task analysis. The results of such an analysis can be used to generate job aids for experts, to help designers structure knowledge-management systems, and for other purposes. If training is not the primary purpose, then the analyst might choose to spend less time identifying the simplest version and other versions (Step 2. Identify the first learning episode). Such information might still be useful for distinguishing experts and novices, even though sequencing course material is not of concern. In this study, the analyst/researcher concluded that this step could have been concluded with significantly less time (approximately 20 minutes less), without diminishing the quality of the results.

Recommendation: Unless using the HTA method specifically for training purposes, perform Step 2, "Identify the simplest version," only if needed to distinguish between experts and novices or as one way of helping the expert access tacit knowledge. As the expert examines various instances of a task in search of heuristics, it may be helpful to distinguish between simpler and more complicated versions.

Effectiveness of the HTA method. The HTA method seemed to be effective in its primary function of eliciting heuristic knowledge from the expert. The types of knowledge delineated in Section 3.2 of the HTA Method were found to adequately cover the range and types of task knowledge described by the expert. The analyst/researcher did, however, have problems managing the two tasks of classifying the expert's knowledge and directing the interview to dig deeper into the expert's tacit knowledge. More practice with the methodology should alleviate this. The analyst/researcher noticed during the analysis that certain verbs used by the expert were indicators of tacit knowledge. Examples of these verbs are: *know*, *like*, *feel*, *see*, *determine*, *understand*, and *decide*. When the analyst/researcher asked the expert why she liked a certain piece of art, she struggled at first to find reasons, but eventually she isolated specific characteristics that distinguished artwork she liked from pieces that she did not find acceptable.

Recommendation: Additional guidance should be developed on how to represent explicit knowledge. Although this analyst/researcher has only begun to research this point, such guidance could come from fields such as task analysis or the expert's specific field. One area of interesting research would be collaboration between the expert and the analyst to develop an explicit representation for knowledge deemed critical.

Guidelines for analysts. Throughout the two interviews, the analyst/researcher made a conscious effort to avoid academic jargon, and the expert seemed to rapidly understand everything the researcher was saying. In

moments where the analyst/researcher caught himself using a technical term, he laughed it off with the expert and used the moment to increase rapport.

Suggestions for Improving the HTA Process

The following is a tentative revision of the HTA process based on the findings of these three formative research studies. The changes and additions are in *italics*.

Phase I. Prepare for Analysis and Design

1. *Decide on a task to analyze and be clear about the reasons for analyzing it.*
2. *Make sure you have enough task knowledge to have a good command of terminology and key ideas.*
   - *Review basic reference materials and try to become familiar with key concepts and jargon in the field.*
   - *It would be better to begin by identifying the simplest version of the task, rather than trying to expand the analysis to the next version.*
3. *Make sure you have enough knowledge about the uses of the task description.*
   - *If the task description will be used primarily for deciding on the content and sequence of instruction, identify the characteristics of the learners and the delivery constraints of the instruction in general.*
4. *Arrange to interview multiple experts.*
   - *Identify at least 2 or 3 experts to interview.*
   - *Plan to complete the analysis with one expert before initiating the analysis with another.*
   - *Plan to interview the least experienced expert first and proceed to interview progressively more experienced experts in order.*
   - *Ask one or more of the task experts to record their performance of a very simple version of the task, and review the recorded material in advance of the analysis; or observe the task expert's task performance.*
5. *Prepare in conjunction with the first (next) task expert.*
   - *Establish rapport with the task expert.*
   - *Introduce the HTA method to the expert.*
   - *Explain basic terms (i.e. guidelines, explanatory models, etc.).*
6. *Prepare for the interview.*
   - *Prepare interview materials (i.e., index cards to summarize critical incidents during task performance).*
   - *Practice the HTA interview process if you are not very experienced in it.*
   - *Arrange the interview logistics (e.g., reserve a conference room where you can work without interruptions).*

Phase II. Identify the First Learning Episode

7. Identify the simplest version. *Hold a focus group interview with multiple task experts, and help them to reach consensus on* the simplest version of the task that is fairly representative of the task as a whole. Also help them to describe the conditions that distinguish that version from all other versions.
   - You may want to use some **other criteria** in addition to simple and representative.
   - *It may be helpful to have the expert briefly discuss* ***closely related tasks*** *and clearly distinguish between the main task and the related tasks during the remainder of the analysis*
   - Ask the task experts to recall the **simplest case** they have ever seen. The simplest version will be a class of similar cases. Then check to see how representative it is of the task as a whole.
   - It may be helpful to start by identifying some of the **major versions** of the task and the **conditions** that distinguish when one version is appropriate versus another.
   - Thinking of different conditions helps to identify versions, and thinking of different versions helps to identify conditions. Hence, it is wise to do both simultaneously (or alternately).
   - There is **no single right version** to choose as the "simplest." It is usually a matter of trade-offs.
   - It is wise to go through this process with **several task experts** together and reach consensus before going on to Step 8.
8. Analyze the organizing content. *With the least experienced expert you have not yet interviewed,* analyze the organizing content (mostly heuristics and descriptive theories) for this version of the task.
   - *8.1 Review the recorded material (or any other visual aid) with the task expert.*
   - 8.2 Ask the task expert to think of and describe **one specific performance** of the selected version of the task to focus on for your analysis, or ask if a videotaped performance would be a good case for you to focus on with the expert during the analysis.

- *It is often helpful to have a videotape of a typical performance of the simplest version of the task, so you and the task expert can review it during the analysis process, but asking the task expert to recall one specific performance and keep it in mind throughout the process is a more convenient and inexpensive, albeit often less effective, alternative.*
- *If you don't have a videotape, It may be helpful to have the expert describe contextual information and particulars of the specific performance, describing how the expert began the case, how it progressed (in sequence), how participants reacted, and how the expert dealt with any problems that arose.*
- *It may be helpful to prioritize the problems/concerns that arose and the decisions/actions that the expert used to deal with them.*

8.3 Decide whether to use a top-down or bottom-up approach to analyzing the content. If top-down, use Step 8.4 and skip Step 8.5. If bottom-up, skip Step 8.4 and use Step 8.5.

8.4 *If top-down approach,* start by identifying the general categories of knowledge that an expert uses, then proceed to analyze each.

- Ask the task expert:
  a) to describe each decision that the task expert made,
  b) to identify the kinds of knowledge that the task expert drew upon to make the decision, and
  c) to describe the specific knowledge within each kind of knowledge that the task expert used.
- The kinds of knowledge are likely to include: steps, guidelines or rules of thumb, explanatory models, descriptive models, and metacognitive/decision rules.
- It is generally helpful to start by asking the task expert if there are any steps or phases of activities that are always performed for this version of the task. If so, perform a procedural task analysis to identify the sequence of steps and to see if any of those steps can be broken down into substeps, but those substeps must be ones that an expert thinks of and uses routinely in performing that version of the task.
- For guidelines, use the following process:
  1. Identify the **goals** for this specific performance of the task under its conditions. *It may help to have the expert explain the goals in task-specific terms rather than in abstract terms and to think of the goals as ideal outcomes.*
  2. Identify all the important **considerations** for attaining each goal.
  3. Identify all the important **causal factors** *that relate to* each consideration/subconsideration.
  4. Analyze each causal factor to identify all **guidelines** that an expert uses to account for this consideration.
- For explanatory **models**, use the following guidelines:
  - For each guideline, ask the task expert for the reasons why s/he believes it works.
  - For interrelated guidelines, you are likely to identify a set of related reasons that constitute a causal model or models.
- For descriptive **models**, use the following guidelines:
  - Ask the task expert what phenomena influenced this particular performance of the task. Try to identify all causal relationships that characterized those phenomena.
  - Be sure to look for multiple causes for each effect and multiple effects for each cause. Also look for chains of causes and effects, and explore probabilities for each causal factor to have each effect.
- For metacognitive/**decision rules**, use the following guideline: Find out what rules the task expert used to decide when to use which steps, guidelines, and descriptive models during the specific performance of the task being analyzed.
- It is wise to query the task expert about any of these kinds of knowledge that are not initially described to you for each decision the task expert made in this specific performance of the task.
- If the *expert uses words such as know, feel, see, understand, like, determine, and decide, that may be an indication that heuristic knowledge underlies that particular performance.*
- *It is often helpful to periodically ask the expert some questions about the chosen case, to keep the analysis focused on the flow of that version of the task.*
- *It is useful to help the expert think about ways the specific case fell short of how it should have been done and to have the expert offer guidelines for how this specific case should have been done.*

- *It is wise to have some kind of reference material to provide contextual information and cues and to help the expert be more precise. During the iterative interview process, the visual aid also helps the expert keep on track.*
- *It may be helpful to use index cards for all of these kinds of knowledge, filling them out with the task expert during the analysis process with one piece of knowledge per card, and arrange the cards in some order on a table in front of both of you, so you can easily switch from one part or aspect of the task to another.*

8.5 *If bottom-up approach, ask the expert to describe each decision that s/he made and the process through which s/he went to make each decision.*

- *After the interview, try to categorize each piece of heuristic knowledge according to these categories:* Steps, guidelines or rules of thumb, explanatory models, descriptive models, metacognitive/decision rules.
- *Be sure to "member check" the interview results with the expert in a later interview to verify/identify the types of knowledge underlying each decision.*

8.6 Ask the task expert to think of **similar performances** of the task that are within the realm of the version of the task you are currently analyzing.

8.7 Repeat this entire process (Steps 5 - 8.6) with the next least experienced task expert to identify any alternative views of the task and the knowledge that underlies its performance.

- For each more experienced expert, you should summarize the previous description of the task and ask the expert to review it, in an effort to reconcile conflicts and select among alternative ways of thinking about and performing the task.

Formative research data indicate that this revised HTA process would have been more effective for the three cases investigated here. It remains to be seen whether or not this revised process will also work well for analyzing other tasks that have heuristic elements. The data in this study indicate that much additional guidance is still needed for conducting a heuristic task analysis. It is our hope that this study will encourage others to conduct additional research to improve the available guidance for analyzing heuristic tasks.

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Dynamic Implementation Seeking Equilibrium Model

Pablo Jose Riboldi
Brigham Young University

Abstract

Implementing exportable instructional systems has always been a problem for instructional developers. Even the best instructional systems lose effectiveness when they are poorly implemented. Researchers have focused their efforts on creating mechanisms to help developers and managers improve and control implementation. However, most of these efforts do not address long-term effects, or take into account how teachers feel and react during the implementation process. This study presents the Dynamic Implementation Seeking Equilibrium (DISE) model, a nonlinear model of implementation for teacher-mediated instructional systems to measure rate of implementation over time. The DISE model's main independent variable, the exportability control factor (ECF), is an intrinsic quality of teacher-mediated instructional systems. ECF is defined as the amount of instructions, support resources, schedules of activities, and accountability methods embedded in the instructional system to delineate or control teachers' actions so they use the system according to the developers' original intent. The DISE model predicts four distinct scenarios: extinction, stable low implementation, stable high implementation, and unstable implementation with catastrophic change. Beyond the implications for the implementation of teacher-mediated instructional systems, this model offers an example of how some of the concepts, techniques, and methodologies of nonlinear dynamics can be applied to the field of instructional systems development.

Dynamic Implementation Seeking Equilibrium Model

The primary purpose of the Dynamic Implementation Seeking Equilibrium (DISE) model is to represent the process of implementation of teacher-mediated instructional systems through time, or, in other words, how much of a given instructional system we can expect teachers to actually use consistently over time.

General Characteristics of the DISE Model

The DISE model is . . .	*instead of . . .*
Descriptive	Prescriptive
Dynamic	Static
Explanatory	Evaluative
Predictive	Reactionary
Generalizable	Interventionist

The DISE model has the following general characteristics:

1. *Descriptive*: Descriptive theories show the effects that occur when a given class of causal events happen, or the sequence in which certain events take place. These types of theories do not favor one set of outcomes over another; they do not prescribe how to improve or modify a situation. The DISE model describes different scenarios of how teachers implement teacher-mediated instructional systems given a set of causal relationships. It does not evaluate one scenario to be preferable to the others, nor does it suggest how to increase or improve implementation.

2. *Dynamic*: Dynamic models are those which take the time variable into consideration as opposed to static models which give one-shot pictures of the environment or assume that the value of variables does not change over time. The variables in the DISE model are subscripted with the time variable. Their values change through time.

3. *Explanatory*: Explanatory models, a special kind of descriptive model, attempt to identify all relevant components of a system and their relationships, to explain the systemic behavior of the whole. The DISE model attempts to satisfy these requirements by analytically identifying the relevant components of the process of implementation and by representing the systemic behavior of this process with two different representational systems: one mathematical, the other schematical.

4. *Predictive*: Predictive models have the potential to describe, to some degree, a future state of the system under scrutiny, given certain present values. The DISE model can be used to predict future rates of implementation of teacher-mediated instructional systems (the dependent variable) by estimating the present values of the independent variables.

5. *Generalizable*: Generalizable theories apply to any situation within the model's scope. This characteristic is a matter of degree and limited by the scope of the theory under development. The DISE model has been

successfully applied to a variety of teacher-mediated instructional systems. However, further research is necessary to ascertain the degree of generalizability of the model.

Roles of Those Involved in the Implementation Process

Before being able to delimit the scope of this study clearly, it is necessary to define the roles of all the participants in the implementation process. These roles will help delimit the scope of the model in the next section.

Developers. A class of instructional designers who generate explicit objectives, validated tests, and materials that are instructional and replicable (*materials developers* according to Burkman, 1987) and whose aim is to have a direct influence on the behavior of individual learners. However, in the context of the DISE model, these developers produce information for a cluster of learners who meet at a specified time, led by a teacher who controls what occurs in the classroom (*micro-instructional designers* according to Burkman, 1987).

Teachers. Those potential adopters of developers' instructional innovations who actually use these instructional materials, leading a group of learners to achieve a certain learning outcome. Teachers are ultimately in charge of deciding what, when, and how to implement the new instructional system. This role is defined in a broad, generic sense referring to the person(s) mediating the instruction; they could be teachers in traditional classroom settings, professors, instructors, trainers, tutors, etc. Also, depending on the scale at which the instructional system is being analyzed, the role of teacher could refer to an individual teacher, or an aggregate of teachers, such as a department, a school, a military or industrial training unit, or an entire school district.

Learners. Those potential adopters who are the ultimate audience and target of the instructional system. Learners should benefit from the instructional system by obtaining new knowledge or skills according to the system's learning outcomes.

Master trainers. Some instructional systems require teachers undergo some sort of initial training or certification training before they are qualified or certified to start teaching those particular instructional systems. Those teachers who teach this type of certification training to other teachers are called in this study master trainers. Their role is important because, even though developers may have included detail instructions on how to "correctly" deliver the instructional system's initial training, it still is their prerogative to deliver this training according to their own interpretations.

Scope Delimitation

The primary purpose of the DISE model is to represent the process of implementation of teacher-mediated instructional systems through time, or, in other words, how much of a given instructional system we can expect teachers to actually use consistently over time. This purpose statement implies two scope limitations about the kind of instructional system under scrutiny: (a) The instructional system has to be exported, and (b) it has to be teacher-mediated.

Exportability means that the instructional system is designed to be used by a group of teachers different from those developers who created the system. To make an instructional system exportable, developers purposefully create devices to communicate their idea of how the system should be used to those teachers who will implement the system. This signifies that implementation starts once developers and change agents in charge of training teachers and promoting the adoption of the innovation leave the scene and teachers are not under the direct influence of those who created or promoted the instructional system.

Teacher-mediated instructional systems require a teacher to present the content to the learner. Teacher-mediated instructional systems pose a special problem for developers. Developers must not only arrange the content for learners, but also guide the teachers' actions to present this content appropriately. To do this, developers create a schema of the instructional environment, delineating interactions, schedules, activities, etc. Teachers also have a special challenge when using teacher-mediated instructional systems; they have to not only understand the content, but also interpret and implement the developers' wishes on how to present the content to learners.

For example, a self-study workbook is exportable but not teacher-mediated, so it is outside the scope of this study. On the other hand, an instructor's manual for a class that teaches word-processing is both exportable and teacher-mediated, so it would be subject to the analysis of this model.

Identified Assumptions

In this section I discuss the necessary assumptions which I have been able to identify. I will explain each assumption. These assumptions are necessary to guide the modeling process while building the DISE model. Because they are assumed, these propositions are accepted as valid; however, their validity should be tested in future research efforts.

Teachers seek equilibrium. This assumption is based on experience, observation, and reflection upon human nature. People in general strive to find equilibrium in their lives. Just as physical systems tend toward a state of equilibrium, teachers seem to have a psychological tendency to seek after a state of equilibrium in their teaching practices. Teachers in particular seek to teach in a personal, uniform way. When teachers change the way they teach, they do so in order to improve their teaching, to polish their techniques, to find better examples and explanations. Those practices that work they keep and use the next time. Those that do not, they change, seeking better ones. All these changes are done cautiously and consciously as they seek to achieve a state of equilibrium where they feel satisfied with the learning taking place in their classes. Granted, this state is elusive and ill defined, but can be observed when a teacher teaches certain contents the same as in previous experiences. The DISE model assumes that teachers seek this state of equilibrium, and when they do not achieve it, they feel increasingly frustrated in an unstable, ever-changing environment.

Exogenous changes, such as having to implement a new instructional system, are disruptive to this equilibrium. Teachers seek to quickly adopt and adapt the features of the new instructional system and reach a new level of equilibrium. Teachers may only introduce changes to their teaching or are willing to try new things when confronted with new content or problems; however, once they find some set of teaching practices that work for them and their students, they often prefer to maintain them and use them time after time with little or no change.

Constant quality. Because the focus of the study is on implementation, it assumes that the instructional system's quality is constant. In other words, the effectiveness of the instructional system is not under scrutiny.

Neutral value of implementation. The DISE model attempts to avoid the pro-innovation bias (Rogers, 1995, p. 100) by describing the implementation process impartially, without assuming that higher levels of implementation are better, or more desirable, than lower ones. This study considers rejection, partial implementation, high levels of implementation, and anything in between as likely outcomes of the implementation process. Therefore, this study assumes not only that the quality of the instructional system is high and constant, but also that if teachers decide not to implement the instructional system or to implement something else instead, learning outcomes are not affected.

Teacher, not learner implementation. The DISE model analyzes implementing the instructional system from the teacher's point of view, without taking into account what learners choose to do. For example, if the teacher asks learners to complete certain worksheets, this study considers those worksheets implemented even if learners choose not to complete them.

Teachers try their best. This assumption implies that teachers eagerly strive to do their best in deciding what to teach and how to teach, putting the learners' instructional interest first. They do so not just because it is a job, but because they maximize their personal enjoyment when teaching at their best. This assumption removes any second-guessing on the motives for teachers' deciding for or against implementing certain parts of the instructional system. The DISE model does not take into account other types of motives.

Teachers are free implementation agents. Teachers are assumed to be relatively free and independent and can choose how they are going to teach their classes. This assumption recognizes that teachers are influenced by the environment in which they work to make implementation decisions; nevertheless, once the classroom door is closed, teachers are basically free to conduct their class however they want. Academic freedom is one of the most cherished and defended principles of the educational system. Teachers endure many things, even shamefully low remunerations, in order to enjoy academic freedom.

Teachers are creative. One of the reasons many teachers teach is to satisfy personal psychological needs. Chief among these are the needs to feel creative and needed. Of course these needs vary in nature and intensity from individual to individual, but teachers have to satisfy these psychological needs; otherwise, a continuous repressed creativity generates feelings of frustration. In this study, the expression "creativity need" is used as a general way to encompass all the personal psychological needs teachers seek to satisfy by teaching. To satisfy their creativity, teachers experiment in their classes with different teaching techniques and strategies, which should be their own creation, until they feel that their students are "getting it." When teachers are told what to do, even if it is something good for the students' learning, it does not satisfy their creativity. In fact, it may make them feel unneeded, superfluous, that anyone could do it. Some of the ways teachers express their creativity is by lesson planning, developing teaching materials, and solving instructional situations through previous experience and improvisation when necessary.

Teachers feel frustrated when they cannot express their creativity. As a corollary of the previous assumption, it is further assumed that teachers feel frustrated when having to repeatedly repress their creativity by having to implement very controlling or highly prescriptive instructional systems. For example, if the instructional system prescribes every interaction between teachers and learners, it would leave little or no opportunity for teachers to express their creativity. In this hypothetical situation, teachers would have to decide whether to comply with the

instructional system and repress their creative feelings or implement less and make some room to express their own creativity. If teachers find that they have to repress their creativity often, it is assumed that these feelings of repressed creativity, of disequilibrium, of being controlled, will lead to teachers' feeling frustration toward the instructional system.

Transfer of training research applies to teachers too. The DISE model assumes that when teachers mediate the instruction as they implement teacher-mediated instructional systems, they need to transfer the information to their own students. This implies that the transfer of training research findings (Bransford, 1979; Clark & Voogel, 1986; Cronbach & Snow, 1977; Mayer, 1980) apply to this study. The transfer of training research will be used to construct one of the variables of the DISE model.

Developers have a specific implementation schema. The DISE model assumes that developers have specific ideas or a schema of how the instructional system should be implemented. Even though developers may not be fully cognizant of their own implementation schema or may not fully represent it in their design, this schema exists and it corresponds to the way the instructional developers would use their own instructional system if they were teaching. Developers express these ideas not only by arranging the content for learners, but also by guiding teachers' actions to present this content appropriately. To more effectively communicate their schema and increase exportability, instructional developers carefully delineate instructions, provide resources, schedule activities, and create methods of accountability.

This assumption is necessary because the implementation of this schema is equal to 100 percent implementation. If a teacher were able to use the instructional system exactly the same way that the developer would, then this teacher would be perfectly implementing the system.

Perfect implementation is unattainable. An assumed corollary from the previous assumption is that teachers are never quite able to perfectly capture the developers' schema. Because of personal differences, communication problems, and previous experiences, teachers cannot attain 100 percent implementation. This assumption is necessary to set the range of the main independent variable of the DISE model.

This section listed the assumptions I was able to identify as necessary for building the DISE model. The next section defines the variables of the model.

Variables of the Model

Rate of implementation (*I*). One way to assess implementation in general is to measure the rate of implementation (I). This is the main dependent variable of the DISE model. It shows what percentage of the original instructional system is being used at each point in time. A value close to 1 shows that teachers are implementing almost everything the original developers intended them to do, that most of the instructional system is being utilized. A rate close to 0 shows that teachers are utilizing only a small portion of the original instructional system.

By choosing to measure rates of implementation, instead of, let's say, actual implementation, the DISE model applies to a variety of settings and permits for comparisons among dissimilar instructional systems—the model is generalizable. However, this choice also implies that the model does not specify what parts of the instructional system will be implemented and which ones will be discarded by teachers, but it only states how much will be implemented. For example, two teachers could implement the same instructional system at the same rate but choose to use different parts of the instructional system.

Initial rate of implementation. The initial value of I (I_0) represents the rate of implementation after initial training, just as the instructional developers pull away from the scene—when the transfer of the instructional system actually occurs. If developers do a good job training teachers in using the new instruction, then I_0 would be high. When developers transfer the new instructional system with little or no effort to inform teachers how to use it, the starting implementation value would be low.

Time iterations (*t*). The subscript (t, $t + 1$, $t + 2$, ..., $t + n$), introduced in the previous paragraphs, refers to how many times teachers have used the system. Thus, t is an ordinal, discrete variable instead of a real, continuous one. In the present context, this makes sense because teachers are not constantly engaged in the instructional process; instead they engage in it at intervals. Sometimes these intervals are very frequent and regular (every day, or even every shift); other times the intervals are over longer periods of time or irregular (semester, school year, or training cycle). The length of the intervals between one iteration and the next also depends on the scale at which we are analyzing the system (an individual teacher, a department, a school, or an entire school district). In the DISE model, every variable that changes through time will have this subscript.

Complementary activities ($1 - I_t$). Another component of teachers' implementation experience is I_t's complement. All the instructional activities teachers perform during one iteration can be thought of as a whole (1). Those activities not prescribed as part of the instructional system which teachers nevertheless purposefully perform, and which yield a perceived positive result, are here called complementary activities ($1 - I_t$). It is recognized that

this is a pseudo-variable because it is defined in terms of rate of implementation; meaning that it is defined by what the rate of implementation is not. This factor represents the successful activities teachers implement in the learning situation that do not originate from the instructional system. Another way of looking at this factor is as an expression of teachers' need to fulfill feelings of creativity and usefulness.

Exportability Control Factor (ECF, K_t in the equations). As mentioned previously, developers strive to communicate their internal schema of the instructional system. However, without direct contact, all developers can do is to train teachers, specify precise instructions, create resources, dictate schedules, and enforce accountability from teachers; in short, they can develop an exportable instructional system. The aim of these exportability devices is to communicate the developers' intentions of how the instruction should work. The amount and specificity of these exportability devices constitute an intrinsic quality of teacher-mediated instructional systems, hereby called Exportability Control Factor (ECF, in the equations, is represented by the letter K). This name suggests the amount and specificity of control devices contained in the instructional system to ensure its exportability.

This new theoretical construct has a decisive influence on implementation. In fact, if a teacher-mediated instructional system is going to be truly exported, developers cannot have any contact with teachers after they receive the instructional system; developers can only influence implementation by designing the system's ECF (through instructions, support resources, schedules of activities, and accountability methods) and the initial rate of implementation, I_0 (through initial training.) Therefore, ECF is defined as the (a) initial training, (b) instructions, (c) support resources, (d) schedule of activities, and (e) accountability methods embedded in the instructional system to delineate or control teachers' actions so the instructional system is implemented according to the developers' original intent.

For example, the ECF of an instructional system is high if it specifies each step teachers need to take in order to continue. A medium ECF would be a system which gives suggestions, explicit ideas, or a choice of exercises for teachers to pick and use or modify. On the other extreme, an instructional system with a low ECF contains broad suggestions of possible courses of action teachers should take, or visionary statements of the ideal state of affairs with few or no specifics.

1. *Initial training*
2. *Instructions*
3. *Support resources*
4. *Schedule of activities*
5. *Accountability methods*

Transfer Alignment Coefficient (T). Before defining this variable, it is necessary to define two related concepts—expected transfer and elicited transfer.

Expected transfer is the type of transfer (near or far) necessary to effectively transfer different types of learning outcomes (procedural or declarative). For example, the expected transfer for a declarative learning outcome is far transfer. The more conceptual the learning objective, the farther the expected transfer would be; conversely, the more procedural the learning objective, the nearer the expected transfer would be.

Elicited transfer is the type of transfer (near or far) most likely to be achieved by the type of instructional strategy (behavioral or cognitivist) the instructional system prescribes teachers to use for teaching different outcomes. For example, if the instructional system uses cognitive strategies for the teacher to teach, the elicited transfer is far. The more cognitive or constructivist the instructional strategy of the system, the farther the elicited transfer would be; conversely, the more behavioral the instructional strategy, the nearer the elicited transfer would be.

Therefore, *transfer alignment*, T, is the correlation coefficient ($-1 < T < 1$) between the expected and the elicited transfer per learning objective. If the instructional strategies used by the instructional system to teach different types of learning objectives elicit the same type of transfer as would be expected for the type of objective, then the transfer alignment would be strong (close to 1, aligned). If there is no relationship between the chosen instructional strategies and the type of objectives (for example, a uniform behavioral approach is used to teach all sorts of learning objectives), transfer alignment would be null (close to 0, unaligned). If the wrong strategy is used to teach the objectives or to teach the teachers how to teach these objectives (as in the case when the instructional system behaviorally prescribes for instructors how to teach cognitivist strategies to achieve cognitivist outcomes), transfer alignment would be negatively correlated (close to −1, misaligned).

For example, if the instructional system deals with procedural learning outcomes and uses behavioral teaching methods, then teachers only need to achieve near-transfer of the instruction to their learners. The type of learning, teaching methodology, and transfer required are aligned.

On the other hand, if the instructional system deals with declarative and conditional learning outcomes but uses behavioral teaching methods, or the system behaviorally requires teachers to use cognitive methods, then

teachers may only be able to achieve near-transfer of the instruction to the learners. Simultaneously, they must realize that the system is inadequate in achieving the level of far-transfer required to meet the declarative and conditional learning outcomes. There is a misalignment between the type of learning, teaching methodology, and transfer required.

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Accumulated Frustration (A_t). Whenever teachers increase the rate of implementation of the instructional system from one interaction to the next ($I_{t+1} > I_t$, the rate of implementation now is greater than that during the previous iteration,) they have to sacrifice some of their freedom to use their own complementary activities and repress their creativity. This repressed creativity generates frustration, which accumulates throughout the implementation process. The amount of accumulated frustration is a function of (a) the personal degree of need to be creative, (b) the tolerance to repress this creativity, and (c) the difference in rates of implementation ($I_{t+1} - I_t$.) whenever this difference is positive. Only upward changes in the rate of implementation accumulate frustration. When teachers suppress their creativity in order to increase implementation, $(I_{t+1} - I_t) > 0$, frustration accumulates proportionally to this increase. It is assumed that when implementation decreases, $(I_{t+1} - I_t) < 0$, frustration remains static. The definition of this variable is based on the previously stated assumption that teachers feel frustrated when they cannot express their creativity.

The six variables discussed—rate of implementation (I_t), time iterations (t), complementary activities ($1 - I_t$), exportability control factor (ECF, K), transfer alignment (T), and accumulated frustration (A)—are used to model the dynamic process of implementation for teacher-mediated instructional systems. Next, the relationships among these variables are presented to build the DISE model.

Relationships among Variables

Implementation as a function of Exportability Control Factor. By definition, developers design their instructional systems with a certain degree of ECF. This depends on the amount and specificity of initial training, instructions, support resources, schedule of activities, and accountability methods included in the system. The main purpose of ECF is to ensure exportability, to exercise some sort of pressure to implement the instructional system. This pressure influences teachers' decisions on how much of the instructional system to implement, and how much of their own complementary activities to include. This relationship is represented by Equation 1 (All the equations are found in Figure 1 at the end of this document.)

Implementation as a function of previous Implementation. One of the most powerful influences on a teacher's future rate of implementation is that teacher's previous implementation experience with the instructional system itself. Most teachers are constantly monitoring their own teaching practice, looking for those things that work to repeat them in the future, and identifying those things that fail to avoid them. The way they implemented the system the previous time (t) they used it is going to strongly influence the rate of implementation of the system at $t+1$. For example, the way a teacher uses a particular instructional system during today's science class will largely depend on the perceived results of the previous time the teacher used the system, probably the day before during the science period. See Equation 2.

Implementation as a function of previous Complementary Activities. Another force influencing a teacher's future rate of implementation is the effect of previously implemented complementary activities. Those activities not prescribed as part of the instructional system which teachers nevertheless purposefully perform, and which yield a perceived positive result, the complementary activities, tend to lower the rate of implementation the next time teachers use the instructional system. This is represented by Equation 3.

Combining all three relationships. The discussion, so far, posits that future rates of implementation are a function of previous implementation, previous use of complementary activities, and ECF. Now, these three are combined in a logical manner.

As previously stated, the assumption has been made that teachers seek to achieve a state of equilibrium in their teaching practices. Thus, when faced with the implementation of new instructional materials, teachers will seek

to integrate the new materials with their own instructional practices until they achieve a state of equilibrium. They will try different mixes of components of the instructional system and complementary activities until they are satisfied with the new way of teaching. This process takes some time; implementation changes through each iteration until the new equilibrium is achieved. The equilibrium-seeking process is represented by the balancing feedback loop at the top of Figure 2. The delay in the feedback loop represents the t variable, the time interval between each iteration when teachers evaluate their previous implementation experience which influences their next implementation.

Equation 4 is not only the simplest model, but also one that appropriately combines the logical relationships among the factors affecting implementation, including ECF. It shows how I_{t+1} is proportional to the product of I_t and $(1 - I_t)$. Equation 4 should be interpreted as follows: "The rate of implementation for the next time the teacher uses the instructional system depends on the interactions among the exportability control factor of the system, the current rate of implementation, and the current amount of complementary activities." This equation is one commonly referred to in discussions of chaos theory, and it has been applied to model a variety of settings including population growth (May, 1976), population growth of urban areas, economic growth limited by technology, city development limited by existing infrastructure (Cartwright, 1991), and organization of social environments (Marion, 1992).

Graphically, this equation is represented by the balancing loop between I_t and $(1 - I_t)$ and the external influence of ECF diagramed in Figure 2.

The effects of Exportability Control Factor and initial implementation on the final rate of implementation. The mathematical representation of the DISE model, thus far, affords the opportunity to analyze the model's behavior from different perspectives. For example, with Equation 4 the behavior of how I_t changes over time can be analyzed. As mentioned earlier, instructional developers can only influence ECF (directly through instructions, support resources, schedules of activities, and accountability methods) and the initial rate of implementation, I_0 (indirectly through initial training.) However, according to Equation 4, no matter what the value of I_0 is, teachers would tend to implement the instructional system at about the same rate after some time. The long-term implementation of teacher-mediated instructional systems is determined by the system's ECF and not by the initial rate of implementation.

This, however, should not be construed as implying that these teachers would implement the system exactly the same way. The DISE model only shows rates of implementation, but it does not specify what parts of the instructional system will be implemented and which ones will be discarded by teachers. Also, the complementary activities, which in these cases are about one-third of what the three teachers do in their classrooms, are most likely going to be different.

The effect of Time on Exportability Control Factor. As mentioned earlier, ECF is an intrinsic quality of instructional systems and as such it is constant; however, teachers perceive this quality differently depending on several factors. Among these, time is an important factor which changes a teacher's perception of ECF. For example, as teachers gain experience with the instructional system, they become more familiar with it and feel more comfortable with it, thus, their perceived ECF should decrease slightly. In order to account for these changes, the constant ECF (an intrinsic quality of the instructional system) should be changed to a variable ECF (the exportability control of the system as perceived by a teacher at a point in time). The constant ECF could be used as a predictive tool to guide the design process. The variable ECF should be used as an explanatory tool during the actual implementation process. Therefore, to model the changes in perceived ECF, a t subscript should be added to this variable, as shown in Equation 4. Within the context of the DISE model, I call Equation 4 the *implementation equation*.

The effect of Transfer Alignment Coefficient on Exportability Control Factor. Now the attention is turned to the next variable of the DISE model, transfer alignment coefficient, T. What would be the effect of the transfer alignment coefficient on perceived ECF, K_t?

It is theorized that an aligned instructional system, one with a positive transfer alignment coefficient, would have the effect of reducing the perceived ECF because teachers would feel more confident on the instructional soundness of the system. Even highly prescriptive instructional systems, with ECF < 3, would seem less controlling when the system's instructional strategies are aligned with its learning objectives.

Conversely, a misaligned instructional system, one with a negative transfer alignment coefficient, would increase the perceived ECF because teachers would feel confused by not being able to efficiently transfer the instructions found in the system to their teaching situations.

It is further theorized that unaligned instructional systems, transfer alignment coefficients close to zero, would have little or no effect on perceived ECF. This unalignment would just solidify teachers' perceived ECF.

A simple way to model this relationship is to subtract the transfer alignment coefficient from the perceived ECF, $(K_t - T)$. This relationship is shown by Factor 5 in Figure 1.

The effect of Transfer Alignment Coefficient on Complementary Activities. Furthermore, transfer alignment coefficient also has an effect on how teachers evaluate the effect of complementary activities. Positive transfer alignment coefficients would strengthen the influence of previous implementation, I_t, over complementary activities, $(1 - I_t)$ because aligned instructional strategies would be more appealing to continue implementing. Conversely, negative transfer alignment coefficients would strengthen the influence of complementary activities, $(1 - I_t)$, over previous implementation, I_t, because in these situations teachers would feel more justified to continue implementing their own activities.

The DISE model mathematically represents this relationship by dividing the complementary activities factor, $(1 - I_t)$, by $(1 + T/2)$, showing that a positive transfer alignment would lower the pressure to implement complementary activities. This relationship is modeled in Factor 6.

From my limited experience analyzing instructional systems, I suspect that most instructional systems are unaligned (T close to zero) because developers would tend to apply similar instructional strategies, those with which they feel most comfortable, to address different types of learning outcomes. For example, behaviorist instructional developers are likely to apply behaviorist learning strategies for all types of learning outcomes, be they procedural, declarative, or conditional. The same could be suspected of cognitivists and constructivists. I also forward that aligned instructional systems (T close to 1) are more likely to be those systems which have been carefully designed, paying close attention to address learning outcomes with appropriate instructional strategies. This implies that transfer alignment is unlikely to happen accidentally. Hopefully, I propose that misaligned instructional systems (negative T) are rare.

The Effect of Transfer Alignment Coefficient on Implementation. The combined effect of transfer alignment on future implementation can be deduced from the discussions in the previous sections. A positive alignment would have the effect of increasing implementation because teachers would be more likely to achieve the appropriate type of transfer as they teach with the instructional system. Teachers would be willing to implement more of the instructional system because they could see that the system provided an appropriate strategy for them to teach and achieve the desired results. In a way, this positive transfer alignment would have the effect of dampening the frustration of high levels of ECF. A null transfer alignment would have no such effect, and a negative alignment would actually lower implementation of even instructional systems with moderate levels of ECF.

Accumulated Frustration as a function of increases of Implementation. The definition of the accumulated frustration variable stated that when teachers suppress their creativity in order to increase implementation, $(I_{t+1} - I_t) < 0$, frustration accumulates proportionally to this increase. The assumption was made that when implementation decreases, $(I_{t+1} - I_t) < 0$, frustration remains static. To describe this relationship between increases of implementation and accumulated frustration, A_t, the following Equation 8 is proposed.

Exportability Control Factor as a function of Accumulated Frustration. The last relationship to model is the one between ECF and A_t. It has already been mentioned that feelings of frustration, disappointment, dissatisfaction, and dejection may lead to second-order change. Below a certain threshold value, this type of change is unlikely. Above this threshold, change is imminent (Dooley, 1997). This phenomenon has been studied in neuronal patterns (de Bono, 1969) and managers' decision-making processes (aspiration theory; Cyert & March, 1963; Kiesler & Sproull, 1982). Likewise, each teacher has a tolerance threshold value to withstand the accumulated frustration. Below this value, teachers deal with the frustration the best they can, slightly adjusting their perception of ECF_t due to the familiarization effect. They keep trying to implement the instructional system, probably changing the implementation mix to avoid having to repress their creativity so much the next time they use the system.

If the instructional system's ECF is not very high, implementation reaches stability before the frustration accumulates beyond the tolerance value. However, if the system's ECF is very high and implementation continues to be unstable, more frustration accumulates with each spike in implementation. Eventually, the accumulated frustration will surpass the tolerance threshold value. At this point, what can teachers do? This situation leads teachers to drastically change the instructional system to a less controlling environment by changing the instructional system's ECF.

What are some of the behaviors teachers exhibit that so drastically change their perceptions of the instructional system? Under the right conditions, teachers might go to extreme measures in order to create a more stable and tolerable environment. Some may disregard whole parts of the instructional system; others may quietly put it aside, lobby to their superiors for the system's dismissal or change, stop reporting to their superiors, or invent excuses for not using the system—claiming it doesn't work or that the students get bored. Some teachers may even quit their jobs in order to escape a controlling, intolerable situation; such cases exemplify the ultimate in non-implementation.

Mathematically, to represent the second-order change relationship between ECF and A_t, with slow changes in ECF$_t$ below the threshold value and a drastic change above this value, Thom's cusp catastrophe equation (Thom, 1975; Zeeman, 1976) is adapted, as shown by Equation 9.

As A_t increases, pushed by the upward shifts in implementation (as modeled by Equation 8), K_t diminishes. At first, K_t diminishes very slowly, then as A_t approaches the fold in the curve, K_t diminishes at an increasing rate. When the value of A_t gets to be higher than the value of the right edge of the fold, K_t drastically jumps to the lower part of the curve. This sudden change in ECF represents teachers' decisions to respond to their accumulated frustration by changing the instructional system and transforming it into a less controlling environment. This behavior, modeled by the cusp, is called a catastrophe not because of any negative connotation of the word, but because a small change in the value of the control parameter (A_t) can cause a sudden large change in the value of the independent variable (K_t).

It is important to remember that the catastrophic change only occurs if frustration accumulates beyond the teachers' tolerance threshold level, which only occurs if implementation keeps oscillating in an unstable fashion. This happens when ECF is high and transfer alignment is low, or both. shows the DISE model's behavior when ECF > 3 and transfer alignment is null.

The complete DISE model. is the complete graphical representation of the DISE model. Mathematically, the complete DISE model is Equations 10, 11, and 12 put together in a system of three equations, shown in Equation 13.

The DISE model of implementation for teacher-mediated instructional systems states the following: (a) The rate of implementation is a function of the instructional system's ECF as perceived by teachers, the previously experienced rate of implementation and the complementary activities. (b) This function is a balancing loop which leads to stable rates of implementation. (c) A positive transfer alignment coefficient strengthens the perceived ECF and weakens the effect of complementary activities; in general, it increases rates of implementation. (d) If ECF is high and implementation is unstable, teachers accumulate frustration as they need to repress their creativity when raising the rate of implementation. (e) Below a tolerance threshold value accumulated frustration reinforces the perceived ECF due to familiarization with the instructional system. (d) If implementation remains unstable and frustration accumulates beyond the tolerance point, teachers will drastically change the instructional system to one with a lower ECF.

Implementation Scenarios

The DISE model of implementation for teacher-mediated instructional systems describes five distinct implementation scenarios: (a) extinction, (b) low stable, (c) high stable, (d) unstable with second-order change, and (e) aligned high implementations. Each scenario is discussed next.

Extinction Implementation. When the ECF of the instructional system is very low (between 0 and 1 when transfer alignment is null,) the rate of implementation falls toward 0. Left to themselves, teachers of an instructional system with such a low ECF feel disoriented and unsupported. Teachers cannot find enough instructional support in the system to implement it, so they eventually abandon it. They become confused and uncertain, and at the same time feel pressured to perform their duties. Under these conditions, teachers rapidly abandon the new system and revert back to their old teaching habits, or improvise and create their own solutions, which may or may not be better than the new system but which, at least, provide the much-needed equilibrium the teachers are seeking. I have studied several cases exemplifying this scenario, for example, a case where teachers in an elementary school attempt to implement but quickly abandon a new high-technology classroom program.

This extinction can be correlated with Dooley's (1997) third-order change, where a particular schema survives or dies in a Darwinian, competitive fashion. In other words, teachers compare what they are expected to do against what they have been doing, and decide between one or the other. In this case, the implementation of the instructional system dies and the teachers' complementary activities or the previous "status quo" survive. Notice that this extinction occurs no matter how high the initial rate of implementation (I_0) was; a high I_0 only delays the eventual fate of the implementation.

Stable Low Implementation. The second scenario, when the ECF is between 1 and 2 (null transfer alignment coefficient), can be called Stable Low Implementation. In this case, the instructional system provides enough controls to help teachers try the system on their own and appreciate its virtues. However, the relatively loose control mechanisms eventually let teachers continue using their current, personal instructional methods (fulfilling the individual's need for creativity, recognition, and security). Teachers adopt only those features of the system which are better developed, more closely match their instructional philosophies, and better fill voids in their current repertoire of instructional materials. Under these conditions, the DISE model predicts that teachers will consistently implement only a small percentage of the instructional system (less than half). The model does not predict which

parts of the system they will implement, nor whether different teachers will implement the same parts. A case study essay describing a hypothetical college professor's implementation of a textbook serves as example for this scenario.

Stable High Implementation. When the ECF of the instructional system is moderately high ($2 < \text{ECF} < 3$, $T = 0$), the system reaches the Stable High Implementation scenario (and middle right part in Figure 1). In this case, as in the previous one, an increase in the system's ECF achieves an increase in the stable rate of implementation. However, gains in the stable rate of implementation are smaller than in the previous case (the slope of the curve in Figure 1 diminishes from 1 to 0 in this interval). The increased control included in the instructional system affords teachers a higher degree of security, guidance, and comfort to use more features of the system. However, teachers still feel the personal craving to express creativity, so they take up a portion of the available contact time to implement their own strategies, discarding what they consider the weakest parts of the instructional system. The DISE model predicts that for systems with an ECF close to 3, teachers would implement about two-thirds of the original instructional system in a stable fashion. Again, the model does not predict what parts of the system might be implemented, just that more would be implemented than in the two previous scenarios.

In these two stable scenarios, during the first few iterations, the rate of implementation oscillates around the converging value. These oscillations on the rate of implementation can be explained as what Argyris and Schon term first-order learning (1978). First-order learning occurs when agents change their course of action in order to conform to their perceived schema. This means that for this type of change teachers will adjust what they do in order to conform with what they are expected to do. This creates a negative feedback loop (like the balancing loop in) in which actions converge toward the schema. During this process teachers try different aspects of the new instructional system until their actions converge with the new schema. At the end of this process, they would have achieved a new state of equilibrium. This part of the implementation process is what the DISE model attempts to describe by showing how teachers change the rate of implementation (I_t) and the complementary activities (I_{t+1}) with each iteration until they reach equilibrium.

For these three scenarios, ECF_t changes only slightly, if at all, due to increased familiarity with the instructional system. Equation 10 and are sufficient to model these three scenarios.

Unstable Implementation with Catastrophic Change. The next scenario corresponds to instructional systems with high ECF ($3 < \text{ECF} < 4$, $T \cong 0$). It can be called Unstable Implementation with Catastrophic Change (c and right side of Figure 1.) An instructional system with ECF this high imposes so many expectations on teachers that it constrains their freedom. Teachers have to battle an internal conflict between doing what they are told to do and doing what they want to do. The DISE model predicts that the rate of implementation jumps back and forth between high and low values. In general terms, the higher the ECF, the more unpredictable the rate of implementation will be. This unstable implementation does not allow teachers to achieve the equilibrium they are seeking. The situation becomes untenable. Teachers in this situation become increasingly frustrated with the instructional system, and keep trying alternatively to implement the system and to satisfy their creativity until they have had enough and decide to drastically change this intolerable situation. Teachers do so by changing the instructional system to one with a much lower ECF. Once these sudden changes occur, implementation converges to the appropriate lower rate of implementation.

The right side of Figure 1 shows I_t's behavior when $\text{ECF}_t > 3$; I_t does not settle to a single value. First, I_t suffers a bifurcation and oscillates between two values. As ECF_t increases, I_t bifurcates again and again until it reaches a chaotic region in which I_t does not settle but oscillates aperiodically within a certain range of values. As pointed out before, c shows the time series graph when $\text{ECF}_t = 3.8$. And shows the unstable oscillations with the catastrophic change.

In my research I have documented two case studies exemplifying this scenario. One of them shows how tutors changed a highly prescriptive reading program to a more flexible one. The other one relates the implementation of a series of managerial skills training modules in a business environment.

Aligned High Implementation. The previous implementation scenarios seem to imply that stable rates of implementation cannot be higher than two-thirds. However, these cases assumed unaligned instructional systems ($T \cong 0$, see b). As has been discussed, the DISE model posits that positive transfer alignment coefficients increase implementation. This is specially true for instructional systems with high ECF. Therefore, a highly aligned, highly prescriptive instructional system could see stable rates of implementation even above 90 percent ($I_t \cong .90$). Teachers seem to be more willing to implement a prescriptive instructional system and, if needed, even to repress their creativity when the alignment between learning outcomes and instructional strategies is evident. This is depicted in a.

I have encountered two case studies describing the aligned high implementation scenario. One was a highly prescriptive two-day training workshop with very specific learning outcomes and closely aligned instructional

strategies. The other one was a highly structured reading program where some teachers perceived the program's positive transfer alignment and understood its design and were able to maintain implementation at high rates.

Generalized Propositions Derived from the DISE Model

The DISE model has been presented. I have discussed the model's scope, assumptions, variables, relationships, and scenarios. This last section discusses those generalized propositions I have derived from the DISE model. It is important to remember that these propositions only apply to instructional systems within the scope of the DISE model: teacher-mediated instructional systems. These propositions are offered as generalizations derived from the model and suggest guidelines for developers' instructional design efforts. Their validity is subject to future theory testing and theory improvement efforts.

1. *The rate of implementation of a teacher-mediated instructional system is dependent on the perceived amount of exportability controls embedded in the system (ECF) and its transfer alignment coefficient.* The effect of ECF on implementation was demonstrated by the model in and . The effect of transfer alignment on implementation was depicted in . This proposition implies that instructional developers should pay purposeful attention to how they design an instructional system's initial training, instructions, support resources, schedules, and accountability methods to convey the desired ECF and how they align the system's instructional strategies with its learning outcomes, if they want to improve their chances that the systems gets implemented as intended.
2. *Normally, the transfer alignment coefficient is directly related to the rate of implementation.* This proposition posits that it is unlikely for a misaligned instructional system to have high rates of implementation (see). It also implies that instructional systems with stable high rates of implementation are most likely positively aligned.
3. *The final rate of implementation of a teacher-mediated instructional system is not dependent on the initial rate of implementation.* This was clearly shown by where in spite of different initial rates of implementation, the final stable rate of implementation did not change. This proposition suggests that instructional developers should not spend undue efforts personally emphasizing high initial rates of implementation while they are still around, and implementation, strictly speaking, has not yet started. Rather they should concentrate on communicating the correct ECF and on designing highly aligned systems.
4. *The rate of implementation changes through time until it reaches a state of equilibrium.* This proposition was modeled by the outcome of the different scenarios and exemplified with case studies. According to the DISE model, even for very different conditions, the rate of implementation changes until it settles into a state of equilibrium.
5. *The way individual teachers perceive a teacher-mediated instructional system's ECF and transfer alignment can be different enough to greatly affect the rates of implementation over time.* Teachers' perceptions cannot be underestimated nor easily dismissed. Instructional designers should attempt to estimate these perceptions beforehand in order to design the most appropriate ECF and transfer alignment.
6. *After teachers' implementation reaches a state of equilibrium, only significant changes to these teachers' perceived ECF and transfer alignment could change the rate of implementation.* Such was the case of the implementation I found in one of the case studies where a significant change in the way the master trainers taught the certification training communicated very different levels of ECF to the teachers and they changed implementation accordingly.
7. *A teacher-mediated instructional systems with ECF below a certain level (extinction point) eventually will cease to be implemented.* See a. It is important to point out that, according to the DISE model, this outcome would occur no matter what the initial rate of implementation was. Probably, this is the worst-case scenario, because it wastes the most resources. Instructional developers should be careful not to attempt implementing instructional systems which run the risk of suffering extinction.
8. *A teacher-mediated instructional system with ECF above a certain level (unstable point) will be implemented at a unstable, changing rate for a period of time, until teachers significantly alter the instructional system to one with a lower ECF.* I have found a few examples for this proposition (see). I consider this scenario to be the next worst one because when the catastrophic change occurs, all bets are off on how the instructional system will be implemented. Implementation could fall to a low stable rate or even below the extinction point to zero.
9. *Teacher-mediated instructional systems with moderate ECF (between the extinction point and the unstable point) have a non-zero, stable rate of implementation.* Several cases were presented to illustrate these scenarios (see and b). This type of incomplete or partial implementation is the most common implementation outcome for teacher-mediated instructional systems. This conclusion is supported by Rogers' (1995) evidence of how prevalent reinvention of innovations is and by the effect of innovation configurations as modeled by the CBAM model (Hall & Loucks, 1981). Other studies also support the idea that teachers adapt the instructional system and vice versa (Berman & McLaughlin, 1974, 1976; Davis, Stand, Alexander, & Hussain, 1982; Gephart, 1976).

10. *For teacher-mediated instructional systems with moderate ECF (between the extinction point and the unstable point), as ECF increases, the stable rate of implementation also increases but it does so at a diminishing rate.* This is shown by the diminishing slope of the curve in Figure 1 and . The implication of this proposition is that a developer's efforts to increase implementation by increasing the instructional system's ECF will have diminishing returns on the investment. This effect could prompt the developer to keep increasing the level of ECF, to achieve higher rates of implementation, beyond the unstable point. This could generate an unfortunate outcome.

11. *Initial training can be used to communicate the desired ECF and transfer alignment to teachers.* Developers should pay close attention to this important component of ECF. Nevertheless, unless they are planning to personally perform this initial training themselves, if developers have to rely on master trainers to deliver the initial training, then the initial training itself is subject to the implementation dynamics of the DISE model.

This presentation has described the DISE model in an analytical, step-by-step fashion. The DISE model presents a theory of how teacher-mediated instructional systems might be implemented over time. The model's scope and assumptions were carefully delimited and identified. The variables of the model were defined. The model was then represented using mathematical, graphical, and narrative representational systems, building the model's relationships. Five distinct implementation scenarios were described. Finally, several generalized propositions derived from the model were discussed, suggesting some development guidelines for instructional developers.

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A New Historical Approach to Instructional Message Design: The Case of the *Janua Linguarum* and Its Implications for Foreign Language Pedagogy

Rebekah A. Richards
Utah State University

Abstract

One of the problems that continues to plague teachers of foreign languages at the secondary and university level is the students' use of a "pony," i.e., a literal translation, to assist them in completing their translation assignments. Due to the wide availability of such translations and the tendency for students to choose the path of least resistance, the use of such crutches is not bound to end. Though I would not suggest that it is appropriate in all instances, it is my contention that as teachers of foreign languages, we can guide the students' use of the "pony" in ways that will work to their advantage rather than their detriment, as can be demonstrated through a popular language textbook from the early 17th century. The example discussed in this paper and an examination of the design methodology used by the author of the 17th century textbook also suggest the encouraging conclusion that a new historical approach to instructional design is appropriate and beneficial for modern instructional designers, especially vis-à-vis modern foreign language pedagogy.

Introduction

In this age of technological innovation and "advances," and especially in this very modern field of instructional design, a new historical approach to pedagogy might seem oddly misplaced. However, since we are confronting issues that are literally millennia old and that have been debated in the laboratories of experience for many centuries, we should not dismiss out of hand the solutions proposed and tested by teachers throughout the ages.

As both Classicist and instructional designer, my question is how a new historical approach to Classical language pedagogy, when viewed through the lenses of modern instructional design, informs foreign language pedagogy today. Though my interests and examples deal primarily with teaching ancient Greek and Latin, the methods revisited in this paper can be easily applied to teaching any non-native language.

At the forefront of the controversy in Classical language pedagogy in the last ten years are issues of the changing student profile. The complaints in the pedagogical discourse form a remarkably consistent refrain: the students will not study, the students do not have a foundational knowledge in grammar, the students have no motivation, the students have other priorities (Abbott, 1991; Gruber-Miller, 1998; Kitchell et al., 1996; Phinney, 1989; Sebasta, 1998).

This issue of the new model of student has also been at the forefront of instructional design and educational theory in recent years, but has been cast in a much more objective light. Rather than making a value judgment about their essential quality, intelligence, or background knowledge, educational researchers and theorists have attempted to describe *how* students learn; instructional designers, building on the findings of these educational researchers, have classified types of knowledge and produced theories describing how students learn each type *best*.

In recent years, in an attempt to shake off the shackles of the traditional "grammar-translation" method of language pedagogy inherited from their teachers and their teachers before them, Classical language teachers have largely switched over to a "more intuitive" and more modern approach dubbed the "reading" method (Burns & O'Connor, 1987; Davis, 1991; Gruber-Miller, 1998; Knudsvig & Ross, 1998; Phinney, 1989; Sebasta, 1998). The reading method, though a step in the right direction, is not, however, a panacea. We must continue to look in all corners, however unlikely, for new—or old—ideas that will help inspire language pedagogy with new life. It is in this spirit that I suggest it is time the past was exhumed and examined in the new light provided by modern theories. The eminent Hellenistic historian Peter Green noted that historical interpretation is largely affected by the zeitgeist of the era in which the historian works (1993). Thus, issues considered anew in each succeeding generation continue to yield rich insights. Unfortunately, the historical approach to Classical language pedagogy has been largely dispensed with in favor of more "modern" approaches (Phinney, 1989). Proponents of these approaches claim that they approximate a more authentic learning experience. This goal is a worthy one, and the efforts that have been made should be commended. However, by analogy with the historical insights gained in the last generation in areas such as Hellenistic history, gender studies, and oral poetic composition, I contend that the distantly historical approaches to Classical language pedagogy can reveal unexpected treasures when reviewed using a similar new historical approach.

For the remainder of this paper I will focus on a few of the advantages that could accrue from employing one example of these "old" techniques and methodologies to the modern foreign language classroom. Many of these techniques do not simply provide a way to work around "obstacles" presented by the new profile of student characteristics; they actually work *with* the new generation of students and are, in addition, validated for modern use by modern educational and instructional design theories.

Problems of Foreign Language Pedagogy

Perhaps the most daunting problem facing foreign language students today is the tremendous amount of cognitive resources required for translation (what instructional designers would call "authentic whole-task practice"). While translating a single sentence students must analyze parts of speech, morphology, denotation of words, connotation of words, grammatical syntax, and word order, and then reconstruct the pieces into an idiomatic rendering in their native language; add to this the pressure of "performing" in front of peers and instructor or for a grade, and it becomes apparent that even in its simplest form (i.e., for the shortest sentences), the act of translation produces a nearly constant state of cognitive overload.

The teacher's most common solution to the problem of cognitive overload is to deconstruct the practice as far as possible into its various component parts, as is evidenced by the plethora of vocabulary drills, memorization of grammar rules, and morphology drills available in both computerized and paper form (Latousek, 1998). However, the connotation of vocabulary can only be understood in context, that is, in conjunction with other words, and therefore cannot be effectively practiced simply by drilling single word equivalents as though they were the times tables. The same is true for appreciating the style and interpreting the tone of an author or passage. The result of drilling individual component skills is, consequently, a decontextualized, fragmentary type of knowledge that is often difficult to integrate during authentic whole-task practice, i.e., translation. The dilemma, though, is that without making some of these component skills recurrent or automatic by drill-type practice, the task of translation is essentially hopeless for the novice.

The obvious solution to the instructional designer is to scaffold the authentic task at various levels by recombining component skills to form intermediate practice tasks. But identifying a solution is the easy part. The more difficult question is how to implement that solution. It is for answers to difficult problems like this that we can and should look to the past for illumination.

Bathe's Language Methodology

In the early 17th century, William Bathe, an Irish Jesuit stationed at Salamanca, Spain, wrote a stunningly successful language manual, the *Janua Linguarum* [*The Gate to Languages*], based on his innovative pedagogical theory. The textbook, designed for students of both modern and "scholarly" languages, saw numerous editions published throughout the 17th century and was used to teach at least 8 different languages. Surprisingly, 11,000 copies were printed in Puritan England alone—though, for obvious political reasons, without attribution to its Jesuit author. Bathe's book also formed the basis for several other pedagogical methods. For example, upon comparison with Bathe's text, the *Janua Linguarum Reserata* of John Comenius, which has come to be regarded as the first modern "textbook" in the West, is discovered to be little more than a cheap imitation of this well-known and widely-acclaimed text (Corcoran, 1911).

As an instructional designer, who by definition believes that a systematic approach to designing instruction will produce a superior instructional product, I consider the overwhelming success of the 17th century textbook a natural result of an underlying systematic instructional design. The introductory matter reveals an astounding anticipation of ISD models as well as a deep understanding and appreciation of factors that significantly affect learning, as the following discussion and passages from Bathe's text will show.

Analysis

As Allison Rossett so convincingly demonstrates in her recent exegesis (1999), the analysis phase of the design process is essential to the success of the design itself. Bathe was not unaware of the importance of defining the need for his method, the target population for his manual, the component tasks that constitute the authentic whole task (i.e., translation), and the objectives on which he would focus in creating his manual and explicating his method.

Needs Analysis

In the second chapter of the introduction to his first edition of the *Janua*, Bathe identifies the need for his new language methodology. He states:

> For learning languages...only two ways have yet been found: the 'rule-way,' such as grammar applied to note the concord of words, and the 'ruleless-way,' the ordinary plan of learners of common tongues through reading and speaking. The two ways are related to each other, in that the 'rule-way' gives more sureness, where the 'ruleless-way' more ease in learning. The former is to be preferred where the language is not in common use, the latter in case of a [modern] tongue. But if a 'via media' [middle way] can be thought out, which would equal the 'rule-way' in sureness, and the 'ruleless-way' in ease, it would beyond question be placed several degrees higher than either. Such a way we have here...undertaken to point out. (as cited in Corcoran, 1911, p. 72).

It is interesting that several centuries before Dave Merrill arrived on the instructional design scene, Bathe was driven by the mandate to make instruction more effective and efficient and consequently more appealing.

Target Population Analysis

Bathe defines the target audience for his method in the preface to the first edition of the *Janua Linguarum*: "this manual," he says, "is chiefly for those men who are missionaries in foreign regions...to learn the foreign languages" in use where they were serving. "It is also for confessors," he continues, "so that they can understand the meaning of the feelings concealed in the hearts of the foreign peoples..., especially for confessors in those areas which foreigners frequent." He adds that the book is for "those of advanced years who have been deterred from taking the orders by the tediousness of grammatical studies." It is also, he says, for those "for whom the work of learning vocabulary for many years is vexing, who do not wish to undertake the work which is common to the 'intricate' method in popular use. This manual," he says, "yields a more fruitful command of vocabulary for students of grammar and rhetoric in three months than any other will in three whole years; this is true," he claims, "not only of the vocabulary of the modern languages, but also for Hebrew, Greek, and Latin." He goes on to say:

> It is very appropriate for teachers who wish to teach the fundamentals of the vocabulary that occurs in all the authors, for many words in the works examined in the *trivium* courses are contained in this volume. And it will also be helpful for travelers who will by using it be able in the shortest time possible to collect a 'forest' of words used in another country. It will also useful for those who are involved in various business dealings, for example, those who are sent to speak with the heads of state, for learning foreign idiomatic usages in a short time. And it will prove useful for remedying the negative effects of not being able to attend a public school for servants in noble houses. It is for those who wish to spare the expense of years of study in the humanities. And it will assist those who wish to learn the noble modern languages, such as Italian, Spanish, German, and French, in the comprehension of vocabulary. (as cited in Corcoran, 1911, pp. 266-269).

Task/Objectives Analysis

In the first chapter of his introduction, Bathe divides the learning of languages into four elements or component skill areas: words, syntax, idiomatic phrases, and style (Corcoran, 1911). This four-fold division resembles a modern high-order task analysis. Then, in chapter three, he suggests that while both vocabulary and syntax could effectively be learned using his "via media," the first edition of his text would deal only with the first element. From his discussion throughout the introduction, it can be conjectured that Bathe intended to add to the text—or perhaps even create an additional manual—to explicate his method for learning syntax using this "middle way" method. However, he died shortly before the publication of his first edition and was unable to accomplish his plan; but two translators/editors of later editions of Bathe's work took his plans to heart and found a way to teach syntax using his "via media." These two editions will be discussed later. For now, let us remark on the practical wisdom Bathe demonstrated by focusing on an objective relating to a single element in his task analysis for the prototype of his method.

Design

Bathe's prescient anticipation of modern instructional design methodology evident in his extensive analyses of need, audience, tasks, and objectives extended to the design phase, as well. As with the analysis, the primary evidence for his attentiveness can be found in the introductory matter of the first edition. Chapters three through seven, nine, and ten make explicit the plan behind the method and give guidelines for implementing it in later editions. Chapter eight, in fact, bears a startling resemblance to a management plan. Bathe leaves explicit instructions for those who will perpetuate his work about how to do so in accordance with his original design (Corcoran, 1911).

Because Bathe passed away before his product could be implemented, evaluated, and revised, that part of the ISD process were of necessity left to others. As mentioned above, two of the editors of later editions of the *Janua* added to the manual exercises to assist the learner in assimilating the second element of language identified by Bathe: the syntax. There are anecdotal records of experiments with the manual to gauge its effectiveness (Corcoran, 1911); the results of these experiments are commonly reported as testimonials in the prefatory material of various editions of the textbook and are therefore rather historically suspect. However, the important point is that some sort of evaluation was occurring per Bathe's instructions.

Bathe's Ideas about Learning

As an educator, Bathe was aware of many of the problems currently being discussed by modern educational theorists. For example, in chapter three of the introduction to the *Janua*, Bathe explicitly acknowledges the problems of cognitive load and the decontextualization of knowledge caused by rote memorization of definitions and rules. "How is it," he asks, "that in learning syntax some adopt the 'rule-way,' and some the 'ruleless-way,' while in learning words no one sets before himself the 'rule-way,' by thoroughly learning a series of words? For this, three reasons can be given. First, that vocabularies contain many unusual words, useless for the purposes of many learners. Secondly," he continues, "that a close connection exists between many words, and so, when one fundamental word is known as the source of others, these are very easily inferred from it.... When the meaning of one of them is known beforehand, the rest easily follow and so do not call for any special effort on the part of a learner." And finally, he adds, "the third and main reason is that words in a vocabulary [list] lack significance; from this it follows that the memory, deprived of the assistance of the intelligence, cannot keep firm hold on them" (as cited in Corcoran, 1911, pp. 72-73). Bathe's arguments bear an unmistakable resemblance to the tenets of Meaningful Reception Learning as explicated by Ausubel, Novak, and Hanesian (1978).

Bathe's perceptiveness when it comes to learning and to the design of instructional materials, especially when his work is compared to modern theories and principles, was phenomenal. Not only does his acuity lend credence to his historically-acclaimed position as one of the preeminent educators in the post-Renaissance West (Nolte, 1768, as cited in Corcoran, 1911), but it also suggests that modern foreign language teachers and instructional designers alike could derive great benefits from examining and applying certain elements of his methodology and techniques. The following section of this paper will provide an example of how one such technique found in this historical textbook could be applied to modern foreign language pedagogy.

A New Historical Approach to an Old Problem

One of the problems that continues to plague teachers of foreign languages at the secondary and university level is the students' use of a "pony," i.e., a literal translation, to assist them in completing their translation assignments. Due to the wide availability of such translations and the tendency for students to choose the path of least resistance when it comes to completing homework, the use of such crutches is not bound to end. Though I would not suggest that it is appropriate in all instances, it is my contention that as teachers of foreign languages, we can use supplemental exercises to guide the students' use of the "pony" in ways that will work to their advantage rather than their detriment, as can be demonstrated through two specific examples from Bathe's textbook.

The Arrangement of Bathe's Book

One of the more interesting aspects of Bathe's text—and one of the most informative for the problem of modern foreign language pedagogy posed above—is that it employed facing text and translation, much as a modern "pony" does today. The sentences in the language to be acquired were found on the right-hand leaf and the literal translation of the sentences into the native language on the left. Some editors made the translations interlinear while others made multiple columns in order to show the sentences rendered into as many as six languages across the double leaf (Corcoran, 1911).

Though the arrangement of the book appears at first glance to be more an issue of message design than of instructional design, the exercises that encourage the learners to actively engage both the text and translation simultaneously and to manipulate the material in a way that facilitates the abstraction of vocabulary and principles of syntax reveal the centrality of message design in the overall instructional design.

Harmar's English Edition

John Harmar, Regius Professor of Greek at Magdalen College, Oxford, edited and oversaw publication of two English editions of the *Janua Linguarum*. Harmar, in the introduction to his first edition (the sixth English

edition, published in 1623), reports in detail the alterations he saw fit to make to the *Janua*, alterations that were "sufficiently commended both by diverse experiments, and by five editions past." These changes included making the translation "more significant and correspondent to the Latin, and more clearly to reflect on it" (as cited in Corcoran, 1911, p. 98). That is, he made the vernacular translation more precisely literal. He also refined the Classical Latinity of the sentences themselves so they would be of more immediate use to teachers and students of Classical Latin. Finally, he added directions for manipulating the Latin text in such a way as to make the "concord of words" (i.e., syntax and word order), the second element of language identified by Bathe, explicit to the students: he directs the students "to construe by letters pointing out the grammatical position and sequence of the words" (as cited in Corcoran, p. 99). The student, when faced with a sentence such as the one that follows (sentence number 9 of 1200 in the *Janua*), *Hoc momentum, unde pendet aeternitas*, would have written something approximating the following string of letters: Adj[ective] N[oun] Adv[erb] V[erb] N[oun], thereby indicating the part of speech of each word in the order in which it appears in the language to be acquired.

Harmar apparently believed that with the modifications described above the book would displace all other beginning Latin texts, which he styles "elementary trash," for teaching the fundamentals of Classical Latin (Corcoran, 1911). Indeed, by increasing the Latinity of the sentences and the correctness of the translations, he prepared a text suitable for teaching all four of Bathe's elements: vocabulary, syntax, idiomatic phrases, and style. For as the students actively manipulated the text, they would of necessity have encountered phrases and idiomatic translations as well as the general style of the Latin language.

Applications to Modern Foreign Language Pedagogy

Harmar's pedagogical method could be easily adapted to modern use for both ancient and modern languages. Working with a facing literal translation, students could be assigned to use letters to indicate the parts of speech of each element in a sentence in a passage of text by the author being studied. To increase the difficulty of the exercise, the students could be instructed to indicate the syntactical function of each word within the sentence as well as its part of speech and to note differences in syntactical function or idiom between the two languages. Ideally, the passage used for this exercise would be different than the passage used for whole-task practice but by the same author.

Several instructional advantages could be derived from such an exercise. First, the students would be able to focus on syntax and word order without any but the most cursory attention to the semantics of the sentence; such would be the advantage of having a literal translation readily available for consultation. This type of scaffolding reduces the cognitive load, thereby increasing the cognitive resources available to attend to the syntactical patterns. Second, with sufficient practice, the students will eventually assimilate schemata for the syntactical patterns not only of the language in general but also of the specific author under consideration. Each additional sentence analyzed in this way will assist in the tuning of these syntactical schemata (van Merriënboer, 1997). Third, as Bathe himself pointed out with regards to learning vocabulary, the syntax, when situated in an authentic environment is much easier to learn and remember than when learned as a list of decontextualized rules. This last point, again, is the basic tenet of the Meaningful Reception Learning theory (Ausubel et al., 1978).

The Portuguese Edition

In 1623, Dom Mauro de Roboredo published his *Porta de Linguas*, a Portuguese translation of Bathe's *Janua*. He expresses in the preface his intent to "extend the usefulness of the original edition by adding, on its own expressed plan, a Portuguese version" (as cited in Corcoran, 1911, p. 107). In addition to simply adding a literal Portuguese translation of the Latin sentences, he made slight changes to the message design, as well. Roboredo retained both the Latin and Spanish sentences in their original positions but added his Portuguese translation above the Spanish translation on the left-hand side of the page. Then he connected the corresponding elements of the sentences in all three languages with numerals (Corcoran). Using the same sentence from the *Janua* as in the previous example, an example of Roboredo's rendering would have been as follows: *Hoc momentum*, *unde pendet aeternitas*. A literal English translation following the same plan would read: This is the moment from which eternity hangs.

Applications to Modern Foreign Language Pedagogy

This unique element of message design found in the Portuguese edition of the *Janua* suggests possibilities for use in modern foreign language instruction. Using a passage of text in a facing literal translation, the students could be assigned to use numerals to connect corresponding elements in the sentences of the foreign and native languages.

The advantages to this exercise would be several. First, the exercise would encourage students to actively engage both text and translation simultaneously, thereby drawing attention to both the foreign word and its equivalent in the students' native tongue and taking maximum advantage of the scaffolding inherent in such a format. Second, the students would be exposed to much more vocabulary than they would be if they were expected to look up each unfamiliar word in a dictionary (van Merriënboer, 1997). Furthermore, the students would have at their fingertips a model of expert translation: they would see the various nuances of a particular word and also how the literal definitions of words are influenced by surrounding words to form a coherent thought or idiomatic expression (van Merriënboer). Fourth, students are more likely to remember vocabulary when they encounter new vocabulary words in the context of a complete thought, as Bathe himself pointed out. Today we would muster the tenets of MRL as support for this statement (Ausubel et al., 1978). Fifth, the second, third, and fourth elements of language, as articulated by Bathe (i.e., syntax, idiomatic phrases, and style) would also be called to the students' attention as they moved systematically through the passage; and, as mentioned earlier, because the semantics would not be tying up their cognitive resources, a greater amount of attentional resources would be free to assimilate syntactical schemata, idiomatic renderings of certain phrases, and the stylistic patterns of the author under consideration (van Merriënboer).

Conclusions

Contemporary testimonials and the overwhelming popularity of the book on the basis of numbers alone aver that the exercises contained in the *Janua Linguarum* were successful for teaching the rudiments of vocabulary and syntax in the 17th century; but their effectiveness then and their potential for effectiveness now can also be verified by their correspondence to modern instructional design principles and learning theories. The major principles exemplified in the *Janua Linguarum* include: 1) scaffolding novices in several component skill areas to allow them to successfully engage in authentic practice activities as soon as possible (van Merriënboer, 1997); 2) reducing cognitive load by reducing the number of component skills being practiced at one time (van Merriënboer); 3) modeling expert translation (van Merriënboer); 4) increasing the automaticity of rule-based or recurrent component skills through more encounters with vocabulary and syntax (van Merriënboer); 5) assisting the assimilation and tuning of syntactical schemata by encouraging students to make patterns explicit through the use of semantically insignificant symbols (van Merriënboer); 6) requiring thoughtful engagement from the learner (van Merriënboer); 7) encouraging learners to assimilate vocabulary from a meaningful context rather than by rote memorization (Ausubel et al., 1978); and 8) increasing students' motivation to learn by providing authentic early experiences with the texts (Keller, 1987).

It is my argument that the adherence of the exercises from the *Janua Linguarum* discussed in this paper to principles of good instructional design justify not only reinstating this antique use of the "pony" in modern foreign language pedagogical methods, but also justifies using a new historical approach to instructional design to infuse our modern approaches to foreign language pedagogy with the sustaining lifeblood of tried and true methodology.

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Building a "Web-Based High School" Project - A School-University Partnership

Wilhelmina C. Savenye
Zane Olina
Alexander Kim
Howard Kopp
Adamos Nicolaou
Mary Niemczyk
Arizona State University

Herb Dwyer
Tempe High School District

Audience Objectives

1. AECT audience members will be able to describe and evaluate the results of a school-university collaboration that is part of a web-based high school project.
2. AECT members will be able to briefly describe the development and evaluation of four components developed as part of the project: 1. a teacher-training and support needs assessment, 2. a "rookie camp" to support students in using WebCT, 3. an instructional unit to help teachers learn about digital copyright, and 4. a web-based "courselet" to teach students about key elements of the Odyssey of Homer.

Background

One high-school district in the Phoenix, Arizona, metropolitan area, has over the past six years, built its infrastructure to support high-quality technology integration by its teachers. At one high school, McClintock High in Tempe, the technology coordinator, administrators, and several innovative teachers determined that the time had come to take advantage of what technology could now do for their teachers and students. They knew their school was ready to take the next step toward true technology integration.

The school personnel saw this next step consisting of developing several levels of web-based and web-supplemented instructional materials and programs. At one level, they partnered with the Virtual High School (VHS) out of Concord, Massachusetts, to secure access to advanced placement courses for students who could not otherwise take these courses. One teacher enrolled in the VHS's teacher-training program. During this year, five McClintock students were able to take such courses as Advanced International Politics and Advanced Microbiology, all fully web-based courses. At another level, one teacher set out to develop web-supplemented materials, such as web quests, for her lower-level English students. She found that students' interest in these innovative materials seemed to decrease the dropout rate in her course. At another level, it was hoped that teachers could develop web-based "courselets" for many content areas that students who could not attend school, due to illness or suspension, for example, could complete on their own. The school also plans to develop web-based instruction to help students prepare for state-mandated exams (Dwyer & Boyle, 1999.)

The overall goals of the initial plans were to increase access to instruction through these many means, and also to decrease instructional costs. During the strategic planning, the district evaluated several web-course authoring programs and selected WebCT for its major systems, although teachers also have access to other software.

The district had recently passed a bond issue to fund purchases of computer hardware and software, along with significant upgrades of the district's technology, infrastructure, however, here, as elsewhere in our public schools, there is little to no funding for teacher training, student and faculty support, and development of materials.

The Collaborative Partnership

Meanwhile, during spring of 2000, at a nearby university, a faculty member from an educational technology graduate program sought "real-world" projects for students in her advanced instructional development class. A fortunately-timed call to the technology coordinator at the high school, not coincidentally, an alumnus of our doctoral

program, seeded the beginning of a collaborative school-university partnership that has added to the nucleus of the web-based school project.

Initially, the school district and the university program identified several needs which it was hoped would be answered through the partnership. The school district hoped to add a scholarly focus to their technology efforts. They also hoped the graduate students would provide the teachers and staff with an instructional design perspective, to complement the desired exemplary use of technology skills. It was hoped that, in addition to the extra resources the university program would provide, the educational technology graduate students and professor would bring the school and the district a fresh and different perspective.

The university professor and students, of course, hoped to fill their need for advanced real-world instructional design projects, as well as a sort of proving ground for the graduate students in which they, too, would learn more about school needs and applications of technology. Not incidentally, the school district surrounds the university and this close proximity aided all in staying in close touch.

Finally, the university professor and the school technology director, hoped that the personal relationships that developed as a result of the partnership would sow the seeds for future collaborative projects to benefit students and faculty in both the school district and at the university.

Development of the Project

During the spring of 2000, five students in an advanced instructional development course learned about principles of web-based development and course delivery and techniques for conducting needs assessments. For instance, they learned some of the basic principles of distance learning, especially web-based distance learning (cf. McIsaac and Gunawardena, 1996; Kahn, 1997; Moore & Kearsley, 1996.) They discussed how to determine if a course is suitable for web delivery by learning the principles of Porter (1997) and McManus (1998.) They learned about qualities of instructors who are more successful in developing innovative internet-based programs (cf. Beaudoin, 1990; Collis, 1996; Gunawardena, 1992; Muffaletto, 1997.) They also learned about aspects of learner expectations in distance instruction (cf. Moore, 1989.)

The focus of the course then shifted to developing their projects. They discussed advanced instructional design techniques, especially instructional strategies, based on the work of Smith and Ragan (1999.) They also learned how to implement sound instructional design principles in web-based environments (cf. Eastmond & Zieghan, 1995; Hirumi & Bermudez, 1996; Ritchie, & Hoffman, 1997.) They learned about some of the issues facing teachers and students who use the computer-mediated communications that such systems as WebCT allow (cf. Bull, Bull, & Sigmon, 1997; Lewis, Whitaker & Julian, 1995.) Students were reminded of the importance of good visual design in web development (cf. Grabinger, 1989.) Finally, after students developed their projects, they field-tested them according to the principles of Dick and Carey (1996.)

Four projects were completed, all developed in partnership with teachers, technology coordinators and students. These projects will be presented briefly below.

Rookie Camp: An Introductory Unit for Web-supplemented Instruction at the High School Level

The Rookie Camp unit in WebCT provides students with an introduction to the elements they will be working with in a web-supplemented learning environment through (Niemczyk, 2000.) Ease of use is critical to promoting success in computer-assisted instruction. If the students continually need help in overcoming obstacles in the software, they will become frustrated quickly (Heinich, Molenda, Russell, & Smaldino, 1998). Though it is probably true that many high school students have some computer experience, relatively few have had exposure to using the web as part of their classroom instruction. In order to insure success, the learners need to be ready to work with this new tool. Learner readiness involves gaining competencies in using navigation tools and becoming familiar with the learning environment (Twigg, 1999; Winiecki, 1999).

In order to ease the transition to web-supplemented courses and promote success, the Rookie Camp unit was developed. Rookie Camp focuses on the tools and working areas of WebCT in the "default" course template. Explanation of the course homepage depicting nine icons is described. Each of the nine icons and the course management tools they represent are then explained in detail. After the students work through the Rookie Camp course content, they are provided practice activities, review and a quiz.

This unit will become a "default tool" to be included in all WebCT courses at this high school. Rookie Camp will be the first unit the high school students in web-supplemented courses will go through. (For a more complete description of this project see Niemczyk, Dwyer, & Savenye, 2000.)

Poetic Devices and the Epic Hero in the Odyssey of Homer: *The Odyssey* Project

Two graduate students (Kim & Nicolaou, 2000) developed a web-based unit to help teachers teach *The Odyssey*. The project was designed to be used both as a stand-alone unit and a supplemental unit of instruction, either synchronously or asynchronously. The project was designed to meet the teacher's needs, as well as the school partner's need of creating a working model and template of what a web-based course should look like. The unit teaches students how to identify several poetic devices and epic hero qualities in given passages. It also allows students to explore an interactive map of Greece and the Mediterranean region, with references to events in *The Odyssey*.

The project was developed over a period of several weeks, and was used and tested at the end of the school partner's spring semester. The project was field tested with eight 9th grade English students. Students checked off multiple-choice test items on a web page, and then submitted their answers electronically to the designers. The courselet included an online student attitude survey with 5-point Likert-type questions and open-ended text boxes. Students' attitudes were very favorable. Students reported that they enjoyed using the courselet and would use more courselets like *The Odyssey* unit. Teachers' attitudes were also positive. However, student achievement was rather poor and might have been influenced by the unfavorable conditions under which the field test was conducted (through an unfortunate circumstance, field testing had occurred at the same time as state-wide testing).

Future plans include a revision to include more descriptive feedback and more short activities sections to give students more opportunities to practice what they have learned. More graphics will be added to the instruction as well. The most important lessons learned from this project were that face-to-face teacher-designer meetings need to be frequent and regular, and that time management is critical.

Teacher Training and Support

One doctoral student conducted a study to determine how the district could best train and support teachers in using web-based instruction. In her needs assessment study, she surveyed the literature, researched case studies on the web, and conducted structured interviews and surveys with school district technology coordinators, teachers and the VHS students (Olina, 2000.)

Olina found that the major missing component in most technology-integration projects in schools has been the lack of adequate teacher training and support (Office of Technology Assessment, 1995; President's Committee of Advisors on Science and Technology, 1997.) Based on her preliminary work with the school-district personnel, Olina determined that she would develop a "white paper" that would further inform the decision-making process regarding the implementation of web-based and web-supplemented instruction at the high school and across the district.

Olina's major findings include:

- The most common barriers to technology integration in teaching are the increased preparation time, a lack of awareness of the general benefits of distance education, faculty compensation and incentives, access to appropriate technologies, a lack of shared vision about distance education in the organization, institutional barriers, and a lack of support staff to help with course development (Berge & Muilenburg, 2000; Moore & Kearsley, 1996; Office of Technology Assessment, 1995.)
- The University of Illinois Faculty Seminar Report (1999) highlights the need for teacher training, both to help faculty adapt their pedagogical styles to the needs of online teaching, and to learn their roles in moderating online class interactions.
- It is advisable to focus training on the use of technology on teaching itself, rather than on skills using software.
- Systemic support systems should be developed to address the major barriers to technology integration described above.

A few of the implications described in Olina's white paper include:

- Develop a clear vision for technology integration that is directly linked to improvement of classroom practice.
- Set up a campus-wide task force for technology integration.
- Allocate adequate financial resources for teacher professional development.
- Use a wide range of professional development strategies that are tailored to the particular needs of different groups of teachers. (For a more complete description of this project see Olina, Dwyer, & Savenye, 2000.)

Digital Copyright for Teachers

The final project developed as part of the partnership concerned helping teachers learn about copyright issues related to web development. Kopp (2000) developed a prototype design for a web-based self-instructional unit to help teachers learn about copyright issues in the digital age. Teachers learn how to identify material that can be copyrighted,

how to secure copyright permission, and how to follow guidelines of educational use of copyrighted material. The prototype materials have been field-tested with teachers and are currently being revised for dissemination.

Implications

With the explosive growth of the internet, many schools and universities are turning to the internet to both supplement traditional course materials, in web-supported courses, and to deliver fully web-based courses.

We believe collaborations among organizations like ours hold great promise for building and developmental-testing high-quality learning materials for students and support for teachers. The school district was able to leverage its resources and teachers' time to work with university personnel and complete four projects for students and teachers.

In developing our partnership we learned many lessons. Among them are:

- People, not institutions, build relationships.
- The needs of both parties must at all times be attended to.
- There is an advantage to informal, rather than formal, partnerships.
- All parties need to have a flexible attitude.
- The right people at the right time make up the right partnership.
- The results of the partnership reflect the levels of involvement of all.
- Success builds over time.

In the future we plan to continue the partnership with a continuing emphasis on informality and quality rather than quantity of projects and goals. We intend to expand the partnership to other courses and programs at the school district and university, as appropriate. We also will continue to explore web-based technologies for communication among the partners and to look for increasingly innovative ways to partner.

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Heuristic and Formative Evaluation: A Case Study Illustrator of a New Technique

Heidi L. Schnackenberg
Kevin Chin
Rocci J. Luppicini
Concordia University

Abstract

In recent decades, instructional computer programs and websites have become increasingly prevalent. Programmers, academics, and free-lance computer professionals have all begun to create what they tout to be instructionally sound products that will help people learn. Many of these products however, are rarely evaluated on any level for various facets of their design. When they are evaluated, it is usually either to gather information about the navigability or functioning of the hardware/software, or even less frequently, to assess how well people have acquired the skills and knowledge taught in the program.

As the value of media-delivered information is increasingly emphasized as a powerful instructional tool, user knowledge gains are becoming more frequently investigated. Formative evaluation techniques that assess learning are often employed. While it is important to appraise this aspect of an instructional program or website, it is also necessary to investigate the functionality of the electronic characteristics of the same program. Heuristic evaluation techniques are rapidly becoming the evaluation method of choice to assess this aspect of instructional programs. Unfortunately, the two areas - functionality and learning - are rarely both assessed within the same evaluation due to time, money, and methodological constraints.

While the growing popularity of media-based instructional programs has advanced instructional design and development techniques, equally efficient and effective evaluation methodologies to correspond to this new manner of instructional design have fallen behind. Current evaluation techniques for electronically delivered instruction are either poor in their methodology or incomplete in their design. Often, all pertinent aspects of instructional programs are not assessed and the learner is left with only a partially-sound form of instruction. A new type of evaluation therefore needs to evolve to keep current with new design and development strategies. A hybrid of heuristic and formative evaluation is proposed.

"Evaluation is a discipline inquiry to gather facts and other evidence that allow an evaluator to make assertions about the quality, effectiveness or value of a program, a set of materials, or some other object of the evaluation in order to support decision making" (Cummings, 1998). As such, evaluation techniques and methodologies exist in many different fields, and are performed on a wide variety of materials, programs, and products. While evaluation in its purest concept adheres to Cummings (1998) definition, particular types of evaluation are performed with specific goals in mind, using unique methodologies. Heuristic and formative evaluations are among the two more prevalent methods used in the field of educational technology at present.

Heuristic Evaluation

Heuristic evaluation is a type of usability testing. Usability testing has its roots in classical experimental methodology (Rubin, 1994) and has experienced popular application in the field of engineering. It is a systematic way of evaluating the functionality of a product (usually electronic) by observing users and recording information about areas of difficulty and ease within a program (Dumas & Redish, 1993). Dumas and Redish (1993) describe five characteristics of every usability test as follows: 1) the primary goal is to improve product usability, 2) individual usability tests also have unique goals that are determined based on specific needs, 3) testing evaluators are actual users, 4) testing evaluators perform authentic tasks, 5) problem areas are revealed through data analysis and modifications are recommended.

Commonly, usability testing is not implemented in its purest form (Nielsen 1993; Whiteside, Bennett, & Holtzblatt, 1988). Costs for full-scale usability tests are perceived to be very prohibitive (Nielsen, 1994), and their methodologies very complex (Belotti, 1988). A simplified method of usability was therefore developed by Nielsen in 1989 called "discount usability engineering" (Nielsen 1989b, 1990a, 1993). One of the most popular types of discount usability engineering is termed "heuristic evaluation."

Heuristic evaluation (Nielsen 1994) engages a small set of evaluators, usually three to five, to examine an interface and assess its adherence to a prespecified set of usability criteria, or "heuristics". Each evaluator progresses through a program individually and either records their findings in writing or verbalizes them to an observer who is present during each session. If an observer is present, he/she is also allowed to assist the evaluator in navigating the site if necessary or to answer other questions that may arise. A debriefing session may also occur at the end of each evaluation session to gather more information. After all the evaluators have completed their sessions, the data is then analyzed and items needing to be revised are identified.

Formative Evaluation

In many respects, heuristic evaluation is not unlike formative evaluation as classically defined in the educational technology literature. Coined in 1967 by Michael Scriven, the term formative evaluation is viewed as a means of identifying areas of modification in the development of educational materials through the collection and analyzation of data from the target population. This is different from "summative evaluation" which occurs after development in order to determine effectiveness (Smith & Ragan, 2000).

Dick and Carey (1996) propose three phases to formatively evaluating instructional materials. These are the one-to-one or clinical evaluation, the small-group evaluation, and the field trial. The one-to-one evaluation stage occurs individually with one to three learners who are representative of the target population. Ideally the three consist of one high-ability, one medium-ability and one low-ability learner. The one-to-one evaluation is utilized in order to identify any factual errors in the instruction and to obtain initial reactions and indications of performance improvement. Questionnaires regarding learner attitudes are generally used as the main data collection instrument.

Once the instructional materials have been revised according to the information gathered from the one-to-one evaluation, a small group evaluation should be performed with approximately eight to twenty learners. Again, these learners should be representative of the target population as much as possible. Learners should be selected at random so that your results can be generalized to the entire population. Two primary purposes for the small group evaluation are to 1) determine the effectiveness of changes made following the one-to-one evaluation, and 2) identify any remaining learning problems that learners may have. In this phase, learner performance scores on pretests and posttests are typically used to evaluate instructional effectiveness. Attitudes toward the instruction are evaluated through questionnaires or follow-up interviews.

The field trial is the final formative evaluation phase that Dick and Carey (1996) discuss. It involves the participation of a randomly sampled group of about thirty individuals who are representative of the target population. It is used to determine the effectiveness of the changes resulting from the small group evaluation and whether the instruction can be used in the context for which it is intended. Much like a dress rehearsal, it provides the last chance to identify and remove any remaining errors or problems. There are many similarities between the field trial and the small group evaluation. The main difference between the two evaluation processes is in the actual authenticity of the materials, learners, procedures, instructors and setting. The field trial should mirror the intended instructional experience as much as is possible.

Several similarities exist between heuristic and formative evaluation. Some experts consider formative evaluation to be the underlying blueprint for heuristic evaluation (Hix & Hartson, 1994). The two methodologies also appear to have similar goals. They both use data collected from a target population in order to make recommendations regarding modifications to a specific product or material in the design and development phases of creation. Both employ the use of surveys, observations, interviews, and various other data collection instruments and techniques. However, despite apparent similarities, there do exist fundamental differences between the two. Formative evaluation primarily focuses instructional and learning strategies, as evidenced by the use of pretests and posttests. Heuristic evaluation concentrates more on the usefulness of a product, i.e. the user interface, navigation issues, etc.

In 1987, Patterson and Bloch called for formative evaluation to be conducted during the development of computer-assisted instruction (CAI). In their article, they propose investigating learning gains, user attitudes, interface and navigation issues utilizing Dick and Carey's (1996) three phases of formative evaluation as a structure. These areas of investigation within educational media products still remain of utmost importance today. However, with the advent of the Internet and the World Wide Web (WWW), as well as the ever-increasing rapidity with which electronic educational products are produced, the implementation of the methodology Patterson and Bloch (1987) propose is impractical in the currently fast-paced realm computerized instruction.

A methodology that would perhaps serve the needs of efficiency, practicability, and still investigate learning, attitudes, interface and navigation therefore needs to be created. The present work attempts to address such a problem with the development and testing of a new method. It consists of a combination of heuristic and formative evaluation techniques. In 1997, Corry, Frick, and Hansen incorporated usability testing techniques into

the development of university informational website. They used many facets of heuristic evaluation as the structure of their investigation. According to their results, this was a very efficient method for exploring interface, navigation, content and some attitudinal issues. Learning, however, could not be measured as the site was informational and not instructional.

The purpose of the present study was to further investigate the use of heuristic evaluation, in conjunction with formative evaluation, as a methodology for assessing instructional websites. Through this type of mixed methodology, not only can attitudes, user interface, and navigation issues be explored, learning and instructional strategies can be investigated as well. An evaluation of this nature, illustrating the proposed methodology, is described in the case study that follows.

Method

Participants

Participants in the study were five students at an urban university in or prior to their first semester in a graduate programme in education. All participants will soon be formally enrolled in a required Human Performance Technology course and participated in the study because the instructional program used in it covers content regularly taught in the course. Although the site content was required course material, the evaluation sessions were several hours long and it was decided that evaluators would be paid a small stipend for their time.

Materials

The instructional materials were designed to teach various Human Performance concepts, including needs analysis, instructional design, and formative and summative evaluation. Actual course content and activities were adapted into an interactive instructional website for the study. The site was created initially with the intention of supplementing an on-site course. The long term goal of the website is to have it serve as a stand-alone, distance-delivered web course.

The site contained a total of 10 instructional modules, a homepage (including the course syllabus and navigation information), and a sitemap. Eight of the ten modules contained multiple-choice and/or constructed-response practice-with-feedback activities. The remaining two modules were solely informational. For the current purposes, the site is supplemental to the on-site Human Performance Technology course. In future, it will be used as the basis for a distance version of the same course. The current URL for the site is http://doe.concordia.ca/etec512_712/index.html

The website contained three overall course objectives and 23 learning objectives. 16 of these objectives were short-term and to be completed within the site, while seven of the objectives were subobjectives of the long-term course objectives. Each of the objectives was taught through a number of screens which presented instruction, five practice-with-feedback items (for the short-term objectives), summaries, and reviews. Seven objectives required selected responses in a multiple-choice format and nine required constructed responses. Practice items consisted of multiple-choice questions with two-to-four response choices for the seven selected-response objectives. For the constructed-response items, participants typed their answer in a field and pressed a submit button. In the next field a sample answer appeared to which participants compared their answer. The site was unable to track each participant's progress by recording response choices due to the inability of the university server to support the necessary interface.

Learners could advance through the site by selecting links to modules from the menu or site map. Once in a module, they could choose to view any screen by selecting a link from a table of contents, or they could simply advance in a linear fashion by clicking "previous" or "next" buttons that appeared on each screen. As the site was programmed to work on either a PC or a Macintosh platform, learners were also able to progress through the site using the navigation options within the web-browser they were utilizing.

Procedures

Prior to engaging in the evaluation of the instructional website, it was ascertained that participants were graduate students in the department of education, who were enrolled in a degree programme. The participants also must not have taken the Human Performance Technology course prior to evaluating the website. These were the only prerequisites necessary for learners to be able to evaluate the website. Permission was given by the participants to video-tape each evaluation session in case the tapes of the sessions had to be reviewed for data gathering purposes.

During each session, each participant was then stationed at a computer terminal and given access to the website. He or she was presented with a list of heuristics and instructed to record errors and respond to the various heuristics while progressing through the site. Participants were also asked to verbalize their thoughts and questions

while utilizing the program (Smith & Wedman, 1988). A researcher sat beside each participant, recording observations as he/she advanced through the site. The researcher answered any questions that arose regarding navigation or content, although he redirected the participants to try to answer content-related questions by referring to the site. Also, the participants were asked questions in response to their comments in order to probe more deeply into the nature of participant statements. Full learner control was given to the participants due to the fact that they could progress through the site at any pace they chose, viewing any screens at any point, with the only restriction being that they must complete all the practice activities that correspond to the short-term objectives.

As the stated previously, the university server would not support any interface that would allow tracking or recording of participant progression through the site, so another method was devised to record student responses to the practice items. After each practice set, the researcher copied and pasted participant answers to the practice items into a separate word document. Correct or incorrect answers to the multiple-choice items were indicated, whilestatements from the participants as to the correctness of their answers in comparison to the sample answers for the constructed-response items were also recorded.

Overall, it took each participant approximately 11 hours to complete the evaluation of the website. As the evaluation was time consuming, participants completed the activity in several sessions which varied in length according to their individual preferences and schedules. Upon completion of the evaluation, each participant was interviewed in a short debriefing session to get any last impressions or thoughts he or she may want to communicate. A paper-and-pencil survey regarding attitudes toward the website, perceived future usefulness, and areas of modification was also administered at this time and participants returned the survey prior to leaving the session.

Criterion Measures

Learner achievement was measured through performance on the practice items. The 35 multiple-choice items were scored either one or zero, and the 45 constructed-response items were scored either two (completely correct answer), one (partially correct answer), or zero (no answer or incorrect answer) according to a scoring key developed by the experimenters. Thus, the maximum possible score on the practice items was 125.

The 32-item attitude questionnaire assessed participants' satisfaction with the material, their perceived future usefullness of the skills learned in the site, and suggestions for modifications. The attitude questionnaire, containing 12 three-choice Likert-type items, seven yes/no items, and 13 constructed-response items, was administered immediately after participants completed the instructional program. A sample item from the attitude questionnaire is below:

Circle how much you <u>liked</u> each of the activities listed below.

4. Receiving feedback that asked you to compare your answers to a sample answer.	I liked this a lot	I liked this OK	I did not like this

Responses to the list of heuristics were open-ended. There were five catagories in which to respond, including site content, site navigation, graphical appropriateness, readability, and communication venues. A sheet where general errors were recorded was included. Sample heuristics are presented below:

Please provide specific feedback (positive and/or negative) on the HPT website regarding the following:

- Site content (information, samples/examples, practice items, answers to practice items, links/resources)
- Site navigation (interface, platform conventions, i.e. buttons, etc., menubar, site map, navigation instructions)

Researcher observations to the think-aloud protocols were recorded per individual participants, per session. Observations were made in a variety of catagories. These catagories were quite similar to the heurstics and included site content, site navigation, graphical appropriateness, readability, and communication venues. Observations on learning and attitudes were also recorded.

Data Analysis

Calculation of simple mean scores for the practice items, individually and collectively, were tabulated to indicate achievement. Responses to the attitude survey were tallied and, for the open-ended items, categories of responses were created. Categories of reponses were also created to calculate data on the debriefing responses, heuristic lists and researcher observations.

Results

Achievement

Mean overall practice item scores per instructional objective are shown in Table 1. Within the "Interventions" module of the Web site, participants scored differently on the two module objectives. Although

participants scored relatively high when asked to classify performance solutions as instructional or non-instructional using a forced-choice format (84%), they scored significantly lower (46%) when prompted to offer possible solutions to given case scenarios using an open-ended question format. Another noteworthy result occurred within the "Practice and Feedback" module of the Web site. When prompted to identify appropriate practice activities for given objectives using a forced-choice format, a perfect mean overall score occurred (100%). Asked to write appropriate practice activities for given objectives, overall participant score lowered significantly (60%). The trend of participants scoring highly on closed-ended questions does not continue with the practice items score from the "Sequencing" module. Participants were presented with various course or workshop and asked to identify their pedagogical components. Participants answered all prompts incorrectly, resulting in an overall mean score of zero (0%). The overall percentage scores of participants ranged from 61.6% to 68.8%, with a mean overall percentage score of 65.3%.

Table 1
Mean Overall Practice Item Scores per Instructional Objective

Instructional Objectives	Mean Score (%)
Classify performance solutions as instructional or non-instructional.	84%
Offer possible solutions to given case scenarios.	46%
Develop sections of responses to given proposal scenarios.	58%
Given various data sets from a needs analysis, develop recommendations based on your conclusions from the data.	68%
Develop sample data collection items from given case scenarios.	68%
Identify well-written instructional objectives .	92%
Write instructional objectives.	66%
Identify appropriate assessment items for given instructional objectives.	88%
Identify well-written assessment items.	72%
Write appropriate assessment items for instructional objectives.	80%
Identify appropriate practice activities for given objectives.	100%
Write appropriate practice activities for given objectives.	60%
Identify the pedagogical components, given various courses or workshops.	0%
Determine whether the evaluations described in given scenarios are formative or summative.	92%
Design a methodology and state the instruments to be used for the type of evaluation indicated in given scenarios.	76%

Note: Total number of Participants = 5.

Attitudes

When asked to indicate liking of activities, participants responded positively to receiving feedback that asked to compare their answers to sample answers, with a majority of participants (80%) saying they liked the activity "a lot". When asked to indicate the importance of activities, all participants (100%) answered that both the reading material presented and relating the information in the Web site to future, practical applications was extremely important. A majority of participants (80%) answered that completing the practice exercises in the module were extremely important.

All participants (100%) did not believe the Web site was too hard for them to understand and complete. All participants (100%) also responded that they were able to successfully compare their answers to the sample answers and they learned important techniques that would be of value in the real world. A majority of participants (80%) found the practice exercises helpful, were able to successfully navigate the Web, relate the information presented to previous learning experiences and felt they would be able to apply what they learned in the Web site to a real world setting. When prompted for the most preferred topic of the Web site, participants mentioned the "Needs Assessment" module the most stating it was relevant, informative and easy to understand. When prompted for the least preferred topic, participants mentioned the "Objectives and Assessment" module the most, stating the practice items as the deciding factor.

Heuristic Commentaries

Participant commentaries per heuristic are shown in Table 2. When asked to remark about the content of the Web site, participants mentioned its unclear and/or confusing wording the most (31% of total heuristic comments made). Despite this, participants also stated that the Web site was clear and useful information was provided (25% of total heuristic comments made). Participants were satisfied with navigation issues (32% of total heuristic comments made). The graphics and reading level was judged as appropriate for the target audience (52% of total heuristic comments made). When prompted for errors within the Web site, the majority of statements (54% of total heuristic comments made) indicated grammatical errors in the content. The grammatical errors may also be a factor in participants stating that the content was confusing (19% of total heuristic comments made).

Table 2
Participant Commentaries per Heuristic

Heuristic	**Number of Responses**
Content	
Unclear or confusing wording.	(10)
Clear and useful information provided.	(8)
Examples with feedback very helpful.	(6)
Inconsistent presentation of content.	(4)
Insufficient information provided.	(4)
Navigation	
Satisfied with navigation issues.	(8)
Inconsistent presentation of content	(5)
Poor design issues.	(4)
Attractive site layout.	(2)
Non-working functions.	(1)
Graphics and Reading Level	
Appropriate reading level.	(11)
Text cut off on screen.	(4)
Insufficient graphics.	(2)
Confusing language used.	(2)
Poor design detracts from learning.	(2)
Communication Avenues	
Hyperlinks useful.	(5)
Sufficient for site.	(4)
Miscellaneous	(3)
Other	
Miscellaneous	(6)
Sufficient practice and feedback.	(3)
Informative content.	(1)
Poor design.	(1)
Poorly written content.	(1)
Errors	
Grammatical errors.	(60)
Confusing content.	(21)
Formatting errors.	(11)
Layout/design errors.	(8)
Miscellaneous	(5)
Non-working functions.	(2)

Observations

When prompted for comments related to navigation of the Web site, many related to the poor interface/layout design of the Web site. Participants were also vocal about the poor presentation of the content when

asked about the graphics and reading level. Many comments about the communication avenues within the Web site mentioned the its high-level access to information (within the site and links to external information sources.) The majority of comments relating to errors in the site related to inconsistent design features and confusing presentation of its content. When asked about the learning and instruction aspects of the Web site, most comments referred to the relevant practice and feedback examples.

Recommendations

Data from achievement on the practice items indicate that participants learned approximately 65% of the content included in the website. This would indicate that while the website appears to be an effective supplement to a course in human performance technology, it cannot at the present time be used as a stand-alone distance delivered web course. An investigation of scores per objective reveals that while participants generally attained successful scores on the selected-response practice items, scores were marginally lower on the constructed-response questions. Participants scored below 60% on objectives where they had to offer solutions to case scenarios, develop proposal sections, and write practice activities. The lowest achievement score however occurred where participants had to identify pedagogical components of an instructional design package. Attitude responses indicated that the directions for this section were unclear and that may account for the 0% success rate with these items. Conversely, attitude data also revealed that participants thought they were quite successful in comparing their answers to given sample answers. This may mean that they thought they scored well on these items but actually did not, or that they were successful in estimating that the answers they created were incorrect compared to the sample. What is clear from this data is that several of the constructed-response practice items need to be modified and that the directions for the practice items on pedagogical components need to be clarified.

Participant attitude data indicated that overall, participants like the site and thought that many of the activities in which they engaged were important. As well, participants responded that the material they learned would be useful in a "real world setting" and the skills they learned could be transferred to situations outside of the web environment. This data is revealing regarding future student potential to engage in learning the information in the website. Distance-delivered web-courses classically suffer high attrition rates. One factor that this is attributed to is motivation level. If students appear to like the website described in this study, as well as see value and transferability in the material, then it is likely that at least motivationally, the site would be a success if it is used as a stand-alone course. As a course supplement, attitude data indicates that it is more than engaging motivationally.

Heuristic response data was successful in indicating various errors within the website. The specific errors were not indicated here as they were not deemed of interest or import to anyone beyond the developers. What is of interest however is the fact that the technique of using five evaluators was successful in finding and documenting various website errors. Further, more general heuristic data revealed that while the reading level within the site was appropriate, the way certain concepts were presented was confusing and needs to be clarified for future use. Navigation issues did not appear to be of great concern as participants responded positively to the methods and venues provided for navigation within the site.

Finally, participant think-aloud responses further iterated the need for clarity of language within the site by requesting more examples and information on presented concepts. Participants also requested that more graphics and charts be included in the site. It could be presumed that this is for visual appeal, but it would also be that the increased level of appropriate charts and graphics will facilitate further explanation and clarity of concepts. Finally, while heuristic data revealed no problem areas within navigation, think-aloud response data indicated a modification to the menubar and "previous" and "next" buttons. Participants st ated that page numbers as well as modules should be included on the main menubar to more easily enable users to move from one point in the site to the next.

Overall, it is clear that with some modification, the current website for this study will be an appropriate supplementary source for an onsite course in human performance technology. However, issues with respect to user learning gains need to be addressed before the site can be utilized as a distance delivered course. Further, the evaluation methodology utilized within this project appears to be highly successful in indicating navigation, attitudinal, informational and motivational issues within instructional websites. It is however still not clear as to how accurately learning gains can be measured using the same methodology. Further investigation of the methodology altering the number of participants used to measure learning gains is recommended in the future.

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Diffusion of the Internet within a Graduate School

Lorraine Sherry
RMC Research Corporation, Denver

Abstract

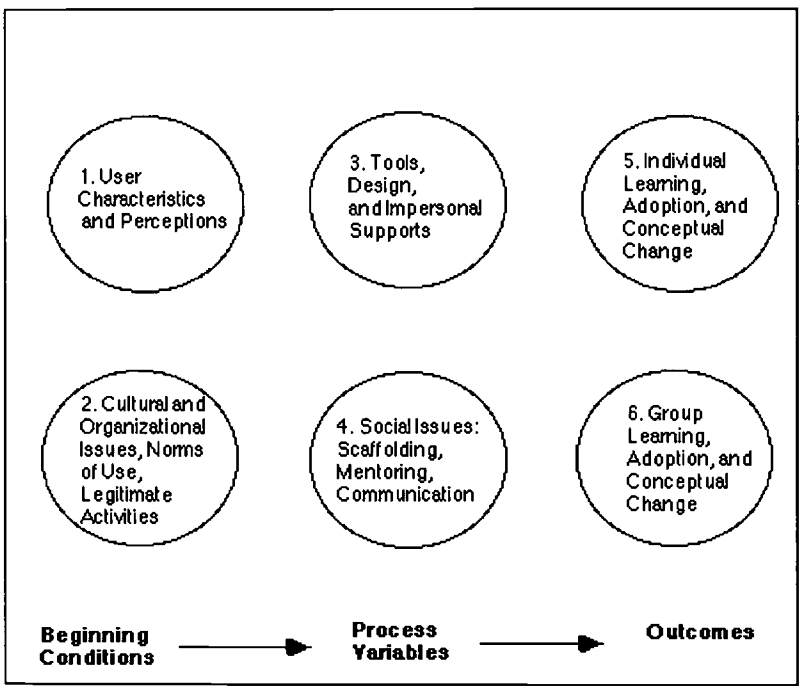
This paper reports the results of a five-year case study of the use of online tools: Internet, e-mail, and the WWW, within a Graduate School of Education. The conceptual framework was independently developed, but because of the striking parallel with activity theory, activity theory became the overall framework for interpreting findings. Ten research questions were investigated using multiple surveys; interviews of faculty, staff, and students; a focus group; and an analysis of electronic artifacts. Principal findings included the following:

- *Self-efficacy x perceived value persisted across time and across programs as success facilitators.*
- *Personal/cultural compatibility, rather than time, separated earlier from later adopters.*
- *"Finding a voice and having something to say", a factor identified under various names by other researchers, posed a barrier for students and faculty alike.*
- *Users valued personal scaffolding but had individual preferences concerning specific types of scaffolding.*

Theory Base

This case study investigated the factors that affect the use of the Internet within a Graduate School of Education (SOE). In this context, "Internet tools" were defined as e-mail, a FirstClass ™ BBS known as Colorado Education On-line (CEO), and the WWW. The study combined both empirical research within the school and an extensive review of relevant literature to identify 28 distinct factors. These factors grouped into six naturally emerging clusters that influence the diffusion of the Internet within the school. (See Figure 1.) These clusters acted as a starting point for formulating a new model of adoption of telecommunications by institutions of higher education.

Figure 1. Clusters of Factors Influencing Diffusion of the Internet



It is interesting to note the striking parallel between Engestrom's (1996) depiction of an activity system and the process that may be occurring in the SOE regarding the adoption and use of the Internet as the activity under investigation.

A key point in Soviet psychology, attributed to Vygotsky, is the emphasis on the use of tools in the development of human mental processes. "The tool is not simply added on to human activity; rather, it transforms it" (Tikhomirov, 1981: 270). Engestrom expands Vygotsky's notion to conceptualize human activity as an interdependent system that ties the individual to the larger cultural context: "Collective activity is realized through individual actions, but it is not reducible to a sum total of those actions" (Engestrom, 1996: 262).

In Engestrom's conceptual framework, known as an activity system, the activities in which an individual engages tend to connect six elements, namely: (a) the individual actor, (b) the object of action together with an expected outcome, (c) the tools used to carry out the activity, (d) the community of which the actor is a part, (e) the norms and conventions of use of those tools, and (f) the division of labor that characterizes individual actions within local collective activities. These elements are all interrelated; changing one will invariably affect the rest of system. The clusters of factors in Figure 1 can be loosely identified with the six elements of an activity system. This comparison is presented in Table 1.

Table 1. A Comparison of an Activity System and the Six Clusters of Factors That Affect the Diffusion of the Internet

An Activity System	Clusters of Factors That Affect the Diffusion of the Internet
Individual or subject	User characteristics and perceptions
Norms of use, conventions, and rules	Cultural and organizational issues, norms of use, legitimate activities, "vision of learning"
Tools or mediating artifacts	Tools, design, and impersonal supports
Division of labor	Social issues including roles, scaffolding, mentoring, communication
Object or outcome of activity	Individual learning, adoption, conceptual change
Community	Group learning, adoption, conceptual change

Empirical Base

The investigation actually began in the fall of 1994, when an ad hoc group of graduate students, together with their advisor, formed the Internet Task Force. During the 1994-95 academic year, the group attempted to identify facilitators and challenges to Internet use within the Division of Technology and Special Services, which housed the instructional technology master's and doctoral programs (collectively known as "I.T."). Later, the population under surveillance was expanded to include the entire School of Education. The purpose of the study was to articulate the individual conceptual changes and group processes of members of the School of Education as they learn the basics of mediated communication, deal with their concerns and learning anxieties, develop expertise, adopt, and eventually reaffirm or reject the use of the Internet to support teaching and learning.

Building on a prior study of Electronic discussion groups, *Using e-mail as an instructional strategy in a graduate seminar* by Wilson, Lowry, Koneman, and Osman-Jouchoux (1994), members of the Internet Task Force explored two facets of Internet usage: *Affordances and constraints of the Internet for learning and instruction* (Ryder & Wilson, 1996) and *Cultural assimilation of the Internet* (Wilson, Ryder, McCahan, & Sherry, 1996). They also studied *The Dynamics of Collaborative Design* (Sherry & Myers, 1998) and documented the work of the Internet Task Force (Sherry, 1996) as the team created the web page for the School, using the university e-mail system and the WWW to share information and negotiate differences of opinion. All of these documents are available on line.

In spring 1995, one member interviewed representative members of the faculty; two others interviewed a focus group of students; and another member (Sherry, 1997) analyzed the results of a survey of 73 students, faculty, and staff regarding their use of e-mail and the Internet for instructional purposes. Five factors emerged from these various studies: (a) clear benefit and value, (b) self-efficacy, (c) finding a voice and having something to say (also referred to as mediated writing proficiency), (d) personal/cultural compatibility, and (e) proper scaffolding.

The first two factors to emerge from these earlier studies, namely *clear benefit and value,* and *self-efficacy,* were identified by Bandura (1982) under his theory of self-efficacy as a mediator of performance and achievement. "Finding a voice and having something to say" was identified by Berge (1997). It was also identified and explored by Fishman (1997) as written communication apprehension and by Sherry (1998) as *mediated writing proficiency.*

Rogers identified the fourth factor, *personal/cultural compatibility* (compatibility between technology and people's learning styles, self-concepts), as one of the five important user perceptions of an innovation – "the degree

to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters". In this study, compatibility includes school policies and norms of use (Rogers, 1995: 15).

The fifth factor was *proper scaffolding.* In Hall and Hord's (1987) *Stages of Concern* model, proper scaffolding is crucial in the personal-concerns stages of adoption when facilitators should visit more often with potential adopters on a face-to-face basis to offer assistance and encouragement. Scaffolding is also important at the management-concerns stage of adoption when it is important to provide "how to do it" workshops that address the constantly changing task issues as they arise (Hall & Hord, 1987: 72).

Two years later (spring 1997), the current study began. The survey was repeated with the same instrument and a stratified sampling of 278 students, faculty, and staff throughout the School of Education. At the same time, a factor analysis was performed on both the 1995 and 1997 surveys to investigate changes in trends over time. Sherry (1998) also repeated the focus group and interviews in spring 1998 using a purposeful selection of students, faculty, and staff, comprising early adopters, early/late majority, and resisters or "laggards". (See Rogers, 1995.)

Results

In 1995, participants primarily used the university UNIX system for their e-mail accounts, except for the few who had commercial or corporate accounts. By 1997, the variety of available tools had increased. 86% of the respondents used e-mail; 74% used the WWW; and 60% used the FirstClass ™ BBS.

Efficacy x Value

A factor analysis of the responses to the survey questions that dealt with reasons for using the Internet (14 items) and barriers/facilitators to using the Internet (11 items) was performed for three subsets of data: (a) 1995 responses (I.T.), (b) 1997 responses (I.T. cohort), and (c) 1997 responses (Non-I.T. cohort). A principal components analysis with Varimax rotation was then performed on the three sets of data. This revealed the general trends and changes over two years and also highlighted the differences between the I.T. and the non-I.T. The results are presented in Tables 2 and 3.

The primary reasons for Internet use: finding information, communicating with colleagues, sharing information, and collaboration (i.e., sharing information to carry out an intentional activity) varied in importance across time and between programs. Note the emphasis on sharing information among the I.T. cohort vs. the emphasis on finding information and collaborating among the Non-I.T. cohort. In contrast, the facilitators to Internet use were remarkably consistent in all cases, with Bandura's efficacy x value accounting for about half the variance.

Table 2. Results of Factor Analysis on Reasons for Use

Survey	1995: I.T.	1997: I.T.	1997: Non-I.T.
Factor 1	Communicate and share information (42% of variance)	Share information (44% of variance)	Find information and collaborate (50% of variance)
Factor 2	Find information (12% of variance)	Communicate (11% of variance)	Share information (11% of variance)
Factor 3	Collaborate (9% of variance)	Collaborate (8% of variance)	Communicate (8% of variance)
Factor 4	Consult with advisor (8% of variance)	Find information (7% of variance)	-

Table 3. Results of Factor Analysis on Facilitators to Use

Survey	1995: I.T.	1997: I.T.	1997: Non-I.T.
Factor 1	Clear benefit and value (33% of variance)	Clear benefit and value (32% of variance)	Clear benefit and value (38% of variance)
Factor 2	Self-efficacy (17% of variance)	Time and access (15% of variance)	Self-efficacy (16% of variance)
Factor 3	Mediated writing proficiency (10% of variance)	Self-efficacy, part 1 (10% of variance)	-
Factor 4	-	Self-efficacy, part 2 (9% of variance)	-

Personal/Cultural Compatibility

In the interviews, students, faculty, and staff alike reported that the e-mail feature of the FirstClass ™ BBS (i.e., CEO) was and will continue to be an efficient means of communication between students and faculty. The faculty consensus was "it's better than voice mail", and students remarked, "I get better response from professors via e-mail than I do by phone calls". Faculty found it convenient to send and receive papers and assignments via e-mail. Students appreciated the more rapid turnaround time that electronic messaging affords. Moreover, responses from the focus group indicated that there was social pressure among some of the learning sub-communities within the school that reinforced the feeling of "If you don't participate, you may find yourself left behind". Both the interviews and the focus group presented evidence that the early adopters tended to be intrinsically motivated, whereas the later adopters often felt extrinsic coercion.

Besides being an accepted and institutionalized part of the school's culture as a handy communication tool, some faculty members predicted that using electronic conferencing and web pages on CEO for distributed learning might prove a viable alternative to traveling long distances to provide classes for geographically dispersed cohorts. At the time the interviews were conducted (spring, 1998), the Administration, Supervision, and Curriculum Development (ASCD) program had eleven electronic conferences on CEO. Their faculty members are actively exploring the use of the WWW to support distance and distributed learning. A few faculty members recently obtained grants to design on-line courses.

Not all faculty and students, however, are early adopters. Early adopters often expressed a good fit between Internet tools and their personal and cultural values. Late adopters voiced concerns about the impact of the Internet on their core pedagogical strategies, indicating that it may not support their vision of learning. Since internal resistance to innovations, especially the use of interactive technologies, tends to change the traditional role of the instructor (Apple Computer, 1995; Yocam, 1998) and his/her core of instructional practice (Elmore, 1996), institutionalization of Internet and WWW tools other than e-mail will most likely take place in fits and starts. A faculty member described her awareness of this resistance:

> *I'm a little bit nervous about the thoughtful use of distributed learning, but I do see that the first and most obvious thing is reaching those audiences that are not otherwise reachable easily. And there's a lot of resistance to that. I'm in big trouble now because I've insisted that next spring when I'm supposed to go to Durango for three weekends [an eight-hour drive from Denver], an equivalent to one of those weekends is going to be distance learning, somehow. They absolutely do not want me to do that!*

Nearly all interviewees noted that there was no incentive system in place for them to adopt Internet and WWW uses other than e-mail. Interview comments made it apparent that it is going to take quite a while until distributed learning – a very different concept from traditional forms of instruction – becomes part of the school's culture.

Finding a Voice and Having Something to Say

In an activity system, the "tool" must have the necessary affordances to enable the actor to carry out an intentional activity – to accomplish an intended outcome. If the tool does not appear to the user to be the most effective means of accomplishing his/her objective, whether due to its inherently unfriendly interface, or to the user's fear of writing to a public audience and leaving an electronic "paper trail", then it will not be used. In this case, if the Internet "tools" do not make communication easier for the user, then all the training in the world will not turn a resister into an adopter.

Students and faculty who are just beginning to experiment with electronic conferencing and online communication sometimes exhibit written communication and lack of mediated writing proficiency. Text-based communication lack social cues, and therefore, may lead to misunderstandings or misinterpretation of the author's intent. Moreover, it is perceived by some learners to be more reflective than spoken interaction. "The very act of assembling one's thoughts and articulating them in writing for a [computer] conference audience appears to involve deeper cognitive processing" (Berge, 1997: 10). This, in turn, may lead to written communication apprehension.

Fishman (1997) found a significant relationship between written communication apprehension and the use of Usenet newsgroups among students who were using a combination of CMC tools in a mediated learning environment called the "Collaboratory". If the network's interface is not particularly user-friendly (as in the older PINE e-mail interface on the university servers), and if students have concerns about their general representational proficiency (the ability to represent abstract concepts in concrete form) or their mediating writing proficiency (writing to an online audience), then these factors could potentially affect the level of use of the network.

This is exactly what Wilson and his colleagues found in the 1995 interviews. It also showed up as the Factor 3 in the 1995 factor analysis of the survey. By 1997, this factor had disappeared from the survey results, but was still flagged by an interviewed student. She alluded to new forms of literacy that needed to be explored and

developed – visual literacy, media literacy, and literacy in terms of the Internet and e-mail – other forms of literacy that she considered appropriate if the school really aspires to be a community of learning. A professor also discussed the additional cognitive skills that are necessary when dealing with on-line text:

> *It's really hard for me to read on a screen. I really want to print things out if there's very much of it and have a hard copy in my hand. What we don't know is the long-term impact of making those kinds of adjustments to the learner. For example, in reading, we learn how to read stories as little kids. We don't know how to read expository text, so that when expository text gets presented to us, it's new, it's different, it's boring We don't have the skills unless those are actively taught to us because the frameworks that we have for reading are about stories.*

This may be one of the reasons why faculty members lagged behind students in publishing on-line documents. Three faculty and eight students who had personal web pages used them to disseminate full-text versions of their publications. Contributors to the school's "Scholarly publications" page, which espouses a clearly stated set of high standards for publication, consisted of nine faculty members (three of whom were UCD students when they first carried out the research on which their publications were based), twenty students, and seven unaffiliated second authors. Another explanatory factor might be faculty members' fear of compromising intellectual property rights; but ownership and copyright issues did not arise in any of the interviews.

A totally different aspect of "finding a voice and having something to say" is the open sharing of promising practices among faculty who have used the Internet and the WWW effectively. Some faculty members are using electronic conferencing, but not all faculty members are aware of the possibilities that this new form of interactive communication and instruction might entail. Faculty meetings generally deal with administrative issues, leaving little time for professors to share innovative instructional strategies that have proved effective with their students. This is beginning to change with the introduction of workshops for honorarium (part time) professors, inaugurated by the University's Office of Teaching Effectiveness (OTE); and with the creation of the new "Teaching and Learning with Technology" (TLT/LTTS) mentoring laboratory for faculty, made possible by a new grant to the School of Education (See Grabinger, paper #199).

Proper Scaffolding

This refers to a support structure that includes a non-judgmental, social support system, one-on-one mentoring relationships, and removal of technical hurdles to the innovation. Existing and proposed supports were divided into two categories: impersonal and personal. Impersonal supports comprised brochures, booklets, on-line tutorials, and other forms of print-based or electronic performance support that do not require one-on-one interaction with a graduate assistant, fellow student, faculty member, or staff member. Personal supports comprised help from graduate assistants, on-line help from the university's network services staff, direct instruction in class, and free workshops conducted by faculty, staff, technically adept students, or other perceived "experts".

Interview participants were asked to suggest improvements to the school's support structure. Survey participants were asked to rank a set of eight supports for training and performance using e-mail and the WWW, with "1" = most useful support and "8" = least useful support. The eight proposed supports were formal classes, brochures, informative booklets, on-line tutorials, paper tutorials, interactive computer demonstrations, individual assistance by graduate students, and workshops. Participants who rated, rather than ranked, the suggested supports, confounded the results in about 5% of the cases.

In 1995, the supports ranked highest by the survey participants were formal classes (ranked #1 by 32% of respondents) and workshops (ranked #2 by 30% of respondents). Booklets were least popular, with over 20% of the respondents ranking them #6 or #8. Individual attention by graduate students was bipolar: 22% of respondents ranked it #8 and 17% of respondents ranked it either #1 or #3. This was worthy of further investigation.

There were significant positive Spearman correlations ($p<.05$) between the self-efficacy factor and the relative rankings of both formal classes (+.026) and individual attention by graduate students (+.029). There was a significant negative correlation ($p<.05$) between the self-efficacy factor and the relative ranking of informative booklets (-.025). This led to the conclusion that respondents who were low in self-efficacy considered personal supports and scaffolding to be relatively useful as compared with impersonal supports such as booklets.

In 1997, formal classes (ranked #1 by 27% of respondents) and workshops (ranked #1 by 32% of respondents) topped the list of preferred supports. Booklets (ranked #8 by 24% of respondents) were still least popular. However, the bipolarity in the ranking for individual attention by graduate assistants had disappeared, with 25% of respondents ranking this personal support as #1. In contrast, on-line tutorials were now bipolar (ranked #2 by 18% and #7 by 19% of respondents). These rankings indicated that the respondents generally preferred personal scaffolding to impersonal supports, but held varying opinions concerning the specific type of support that they would like to see implemented.

Faculty and students alike were often unaware of the range of supports that already existed. For example, the university's network services developed an extensive set of free workshops – exactly the type of 1- or 2-hour workshops that students said they would like to see offered – but students were not aware of them. Brochures, schedules, and job aids explaining various facets of the university's computers and directions for using them were freely available outside the network services office. Copies were also available in the School of Education's computer lab. Again, staff and graduate assistants were not aware of their existence, so they did not publicize them to new users. An important aspect of an activity system – and any system, for that matter – is the fact that for it to function efficiently, information must flow freely throughout the system, to and from all participants. If a support exists, but users are not aware of it (cf. Rogers, 1995, "observability"), then it is like not being there at all!

Recommendations

This study resulted in a set of recommendations for improving access, functionality, training, and technical support; use of communication channels to convey important information about existing support and scaffolding structures; and the use of electronic conferences to enhance and enrich classroom discussions. It also highlighted the need for an incentive system, and for ways that faculty might share promising practices that use the Internet to support instruction.

Based on the results of this study, recommendations for future investigation and development are listed in Table 4. Other colleges and universities that are considering infusing instructional technology into their general education programs (such as PT3 grantees) might find these recommendations applicable, as well.

Table 4. Recommendations

Have better publicity about existing aids and supports, using multiple channels of communication.
Have better communication and collaboration between the School of Education, the university, and the university network services, possibly sharing duties where they overlap.
Develop a flexible schedule of Internet demonstrations or open lab workshops with optional student attendance.
Hire more graduate students in the School of Education computer lab who have the skills and the time to help individual students with specific problems.
Create a permanent position for an in-building technical support person who will be available in person or by telephone when classes are in session.
Consider the possibility of developing on-line tutorials for commonly used Internet tools.
Encourage "show and tell" sessions among faculty members to discuss and share ideas, strategies, and promising practices for Internet use beyond simple e-mail messaging to support teaching and learning.
Encourage students to create on-line research management products and portfolios to serve as models of scholarly products for new students, and to elicit feedback from peers, colleagues, and experts.

Implications for Institutionalization

Based on this study's findings, the use of e-mail will continue to increase because CEO has become a commonly accepted mediating artifact within the norms and conventions of the school. All interviewees and focus group members used CEO regularly in 1997, in contrast with the more sporadic e-mail use in 1995. As members of a commuter campus, students stated that it is more convenient to connect from home or work on a regular basis rather than to travel to campus and pay for parking (which may not even be available!)

Use of the WWW is increasing, and will continue to increase, now that the foremost item on the students' wish list – free ISP service through student fees to the university – has been granted. Students who primarily used CEO were beginning to discover that, contrary to the WWW, a FirstClass ™ BBS does not automatically provide the types of Internet-wide search engines and database tools the they would like. They stated that they would like to increase their access to research-based databases, on-line libraries, collections of legal and medical information -- resources that are freely available on the WWW and that matched their own educational goals. More importantly, there has been a recent influx of out-of-state applicants to the School of Education, who found out about the school's programs via the Web page created by the Internet Task Force, and who are already Internet-enculturated.

As a result of this study, both the School of Education and the university have become more aware that no electronic helpdesk can offer the moral support that new users need as they deal with their personal and task management concerns. There were three notable follow-ons to this study:

- A TLT/LTTS lab was established through a FPSE grant. It exists primarily for the purpose of mentoring faculty in Internet use and other forms of educational technology (See Grabinger, paper #199).

- The university's Office of Teaching Effectiveness (OTE) runs a "Boot Camp for Professors" each summer. This is beginning to gain in popularity and has been particularly successful because it does not interfere with teaching activities during the normal academic year.
- Based on requests for one-on-one scaffolding by faculty as well as students, the OTE inaugurated a new work-study program this summer. A dozen incoming freshmen in September 1999 were paid to take a July 1999 training session known as "Student Instructional Technology Corps" (SITC), where they received instruction that enabled them to serve as I.T. assistants to various academic divisions throughout the university. However, the SITC eventually ran into insurmountable barriers involving early registration and lack of funds for freshman work-study students.

Increased usage will not come without unintended side effects. What is working now may not work in the future. Students with slow modems and insufficient RAM are beginning to feel a sense of frustration with their older hardware platforms. As new users come on board, especially those who are unfamiliar with computer-mediated communication (CMC), they will continue to have problems with modem settings and other software issues. Moreover, as more and more students begin to use their free student accounts for PPP access to the WWW, system capacity will be stressed, leading to carrier drops and busy signals. All of this can be frustrating for new users. Other educational organizations (Sherry, Lawyer-Brook, & Black, 1997) have had to increase their server capacity or purchase additional servers to keep up with increased on-line traffic as new users begin to use the system on a regular basis. Any instructional technology program or educational institution will eventually have to deal with this issue.

Most importantly, linear adoption models such as Rogers' (1995) *Diffusion of Innovations* and Hall and Hord's (1997) CBAM model (in which *time,* rather than *personal/cultural compatibility,* separates early from late adopters) may not apply to learning organizations such as graduate schools. Often, it is the late adopters who have insights into unintended side effects of technological innovations. Moreover, expanded conceptual frameworks that are based on activity theory, systems theory, or complexity theory (see Wilson, Sherry, Dobrovolny, Batty, & Ryder, in press) may provide one with deeper understandings into how individual and organizational learning and change occur over time within institutions of higher education.

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Making them work for the IST online program: A case study

Feng-Ru Sheu
Indiana University

Paul Alford
Indiana University

Abstract

Library service is one of the critical elements for designing a successful distance program in terms of learner support at a distance. Important services of the library model for the Instructional Systems Technology (IST) online program at Indiana University (IU) were identified, based on the needs of students, faculty, librarians, and administrators. Interviews and survey were major methods used in this study.

Introduction

Since higher education involves students in inquiry, research, and critical thinking, library accessibility and support play an important role in the success of distance education. According to Lebowitz (1997), library services to distant students include instruction in the use of libraries and library resources, contact information for requesting assistance from the library, information about requesting materials not available at local site libraries, quick turnaround time for materials requested from the library collection, quick response to requests for reference assistance and guidance, and quick response time to non-library related questions. Usually, the existing library services in traditional universities do not adequately meet the special needs of distance learning. Without equitable access to library resources and librarians, students at a distance cannot perform the same research functions as on-campus students, reducing their academic experience and creating frustration. Such stressful experience could be among the factors that cause a high dropout rate in distance education. As a result, many principles, guidelines, or services have been developed to ensure quality library service for the extraordinary growth of technology-mediated distance learning in higher education (Cooper, 1998).

To develop a quality library service for distance education, the users, the instructors and off-campus students, and the service providers, the librarians and administrators, should be involved. "Regardless of which model is developed and what variation used, it is imperative that institutions and librarians recognize that distance education/off-campus students are entitled to library services which are comparable to those available to on-campus students (Lebowitz, 1997)." To make sure that students at a distance have equal access to library resources, a program designer needs to better understand these students and try to meet their needs and expectations. In addition to students, a designer must consider and support the faculty, who are the key to making all materials alive. Moreover, developing effective library services for distant students is not just a library issue; it can never be tackled without the support of an institution's administrators. Therefore, before a quality library service can be developed, three questions need to be answered. First, what are the expectations and needs of students and faculty in online programs? Second, what kinds of library services are critical to faculty and students in online programs? Finally, are these expectations and needs met by the services offered?

The purpose of this study was to identify important library services for the IST distance program, based on the needs and expectation of students, faculty, librarians, and administrators. The important library services for distance education were identified through a review of the literature, interviews with students, faculty, librarians and administrators, researchers' previous experiences, brainstorming, and discussion with librarians.

Library Services for Distance Education

A literature review was conducted to compile a list of library services for distance education as a framework of this study. Guidelines for distance learning library services developed in 1998 by the Association of College and Research Libraries (ACRL), the nation's largest professional association for academic libraries, was reviewed, along with others suggested in various articles and publications (Brophy, 1997; Butler, 1997; Derlin & Edward, 1997; Jones, 1997; Kirk & Andrea, 1999; MacDougall, 1998; Niemi & Barbara, 1998; Tolsma, 1997). The authors also brainstormed in order to identify potential library services based on past experiences and observations. Considerable overlapping among services derived from these various sources were found and eliminated. Finally, library services for distance education were grouped into the following six categories:

1. **Access to research materials.** The services in this category include online databases, online library catalogs, physical library collections (both at IU and on local sites), and reserve readings.
2. **Delivery of requested materials**. This category includes services for delivering requested materials from the library to a student via postal service, FAX, or various online delivery options.
3. **Instruction**. In order to identify and utilize appropriate library research resources and materials, distant students need librarians' instruction detailing those resources and procedures. Services in this category include providing instruction as part of a program orientation, face-to-face instruction, instruction by phone, online tutorials, and online asynchronous and synchronous instruction.
4. **Help**. While instruction covers more pre-formatted techniques and formal teaching or curriculum such as tutorials, spontaneous or specified questions are answered by "Help" services, which may take the form of lists to browse, FAQ's, or possibly a Knowledge Base. The services in this category related to assistance in identifying subject materials that students may need through the program, highlighting indexes and IST core journals, standard reference books within a discipline, assistance with reference formatting, search help specific to a discipline, and identifying and accessing local library resources.
5. **Policies and procedures**. Available library services, as well as services not provided, should be clearly defined in policies and procedures. Then distant students will know the availability of certain library services, the best way to use these services, and the correct channels of communication. This category includes handling requests from individuals outside the primary audience, referring requests that the library cannot handle to the most appropriate IU or other resource, limits on services, and any costs that students may incur.
6. **Faculty assistance**. Developing relationships and collaborative efforts with faculty will be a critical factor in the success of library services for distance education. This category includes providing faculty assistance on copyright issues and procedures, reserving materials, developing library instructional components, and updating news-and-notes type of current awareness publications.

Methods

Fourteen subjects were initially identified as interviewees based on their substantial experience, potential personal interests, or their involvement in distance education or the IST distance program. Two of these initial candidates, the Associate Vice President for Distributed Education and the Dean of University Libraries, were not interviewed due to time and scheduling constraints. However, administrative perspectives were still sustained by interviewing the Head of the IU Undergraduate Library. While there were minor variations in the questions asked of each interviewee, they typically centered on the following topics: 1) What do you think of when someone mentions a phrase like 'library services for distance/distributed education'? 2) For what type of assignments or information do you/your students/library users use the library? 3) How quickly should students expect a response or delivery of material from library services?

In addition to the interview questions, each interviewee completed a Likert-type scale to rate the importance of specific library services, as they would be applied to the online IST program. This survey instrument was designed to determine *how important* the services are to the institution's faculty, administrators, librarians, and students.

Results

From February through mid-April of 2000, the researchers interviewed each of participants. A list of open-ended questions was initially probed which led to free-thought discussion and, sometimes, brainstorming. The interviews themselves lasted anywhere from 25 minutes to nearly 2 hours. Clearly, some individuals had much to say and sparked some creative ideas. The survey and interview questions were also distributed via e-mail to two students who were not able to physically participate in the interview process because of distance constraints. In all, three faculty members, five librarians, one IST distance education committee member, and four students were interviewed and/or completed a survey, for a total of thirteen participants. Only twelve of these were given the final official survey.

As to open-ended questions, different interviewees repeatedly mentioned a number of issues. Since these comments were unsolicited and unprompted (coming before the survey listing specific services), these indicated commonly perceived essential needs.

Database access was one of the most frequently identified services. On several occasions, the ERIC database was specifically mentioned. Along with the necessity for students to access research databases, the issue of accessibility for students beyond the IU network domain was a concern. Traditionally, the databases purchased by

libraries have only been accessible on campus, while some are more strictly, available only inside libraries. Very recently the libraries have reached agreements with a number of database vendors to allow access to IU students not physically shown on campus.

Closely related to database/literature indexing and abstracting access, availability of full-text databases was repeatedly identified as a critical service. Several databases offered now through IU libraries do contain full-text/full-image inclusion linked to the indexing. The libraries also offer a handy utility for identifying specific journals that may contain full-text entries. An alternative method of offering full-text articles may be accomplished through scanning the materials held by the libraries. While providing the full-text of research items is highly important to student research, the hit-and-miss coverage currently available may create problems in distance learning. For instance, if students are only using items they can immediately obtain in full-text and forgoing the lengthy process of obtaining potentially more relevant and academic items only physically available in libraries, is the academic quality of their research suffering?

Reserve readings also surfaced repeatedly in discussions. Both students and faculty considered electronic reserves to be an essential library service for distance education. While the Indiana University-Purdue University at Indianapolis (IUPUI) Library has offered electronic reserves for several years, the IUB libraries have not yet initiated such a service. Reportedly, the libraries are exploring this with a hoped-for availability by August 2000.

Document delivery was another commonly cited necessary service. Whether through US postal delivery, fax, or online delivery options, interviewees recognized the necessity of having books, articles, or other library materials delivered upon request. It is still unclear exactly what services would be available to IST distant students. While the Library Distributed Education Services Web pages indicated that books and articles from the IU Libraries could be checked out and delivered to distant students free of charge (http://www.indiana.edu/~libdist/des.htm), the Distributed Education Librarian and Head of the Undergraduate Library contradictorily pointed out that books held by the IU libraries would not be delivered to off-campus students. IU libraries similarly would not loan books from other libraries for off-campus students; however, they would interlibrary loan articles from journals the IU libraries would not subscribe to for off-campus students.

Another theme repeatedly expressed by interviewees, and previously mentioned as prominent in the literature related to library services for distributed education, was that distant students should have access to library resources and services comparable to what students with physical access to the libraries would receive. An interesting side note, faculty and students mentioned this more often than did the librarians who were interviewed.

Access to librarians or library staff was another repeated theme. The reasons for contacting library staff may include requesting research assistance, obtaining a quick reference answer, initiating or asking about services, or even asking about other IU divisions or services beyond the library.

Closely related to the above issue regarding access, several librarians interviewed mentioned the necessity of providing a "hand-holding" service to users. Depending on additional student support services offered by IU, the library could well become the "friendly voice" that students seek out whenever they have questions and do not know where else to turn. Students will also need a high degree of personal assistance and attention as they struggle to use online databases or card catalogs, explore where they should look for different types of information, need advice on research topics, etc.

The final major finding from the open-ended questions focuses on the idea of responsiveness. Interviewees were asked a two-part question: (1) "How long should students have to wait for a response to an initial query?" and (2) "If the library will deliver materials directly to students, how quickly should the students expect to get those materials?" The answers showed an enormous range, from immediately to 72 hours for the first question and from immediately (if electronic) to two weeks for the second question. Popular answers for the first part were either immediate acknowledgement of receipt or responses within 24 hours. Popular answers for the second part were either delivery in two to three days or within five days.

In particular, It is necessary to point out the disparity between user expectations and the expectations of libraries. While answers from faculty and students generally indicated a shorter response time, the answers given by librarians tended toward the longer time frames. Distant students would particularly have a need for quick access to library materials and librarians' assistance. If the library services provided were not viewed as responsive, the perception of the service as a whole would have been degraded.

At the end of each interview, participants were asked to fill out a survey to rank their perception of the necessity of several services. The results have been tabulated and are attached as Table 1. Answers were given on a scale of one to five, one being of little relevance and five being highly relevant/critical. The averaged results speak for themselves, but here are some highlights from these findings.

Table 1

	Mean
Access To Research Materials	
- Online Database	**4.92**
- Online Card Catalogs	**4.42**
- Physical Library Collection	**4.08**
- Materials From Other Libraries	**3.75**
Delivery of Requested Materials	
- Postal Service	**4.08**
- Fax	**3.50**
- Online Delivery Options	**4.67**
Instruction	
- Part of Program Orientation	**4.33**
- Face-to-Face Instruction	**2.36**
- Online Tutorials	**4.42**
- Online Asynchronous Help	**4.42**
- Online Synchronous Help	**3.25**
- Phone Help	**4.75**
Help	
- Highlighting Indexes and Core Journals	**3.58**
- Standard Reference Books w/in Discipline	**3.83**
- Search Help specific to Discipline	**3.92**
- Assistance w/ Reference Formatting	**3.17**
- Identifying and Accessing Local Library Resources	**4.00**
Policies and Procedures	
- Handling requests from students/others outside program	**4.33**
- Handling requests & referrals for services not provided	**3.82**
- Limits on Services Provided	**4.67**
- Pass-back costs	**4.75**
Faculty Assistance	
- Copyright Issues and Procedures	**4.50**
- Reserve Materials: Policies & Procedures	**4.50**
- Developing Library Instructional Components	**4.25**
- Library Update/News & Notes publication	**3.67**

Online database access (mean = 4.92) was regarded as highly critical. When options were available for delivery of materials, most preferred the ability to send or receive these through online venues (4.67). Several instructional methods were desirable for librarians to teach and to guide users in resources and procedures, but most respondents agreed that phone contact (4.75) was a necessary service to provide. While the policy and procedure questions focused more on helping library staff, the overall response indicated that users should be made aware of the limits (4.67) and pass-back costs (4.75) for services offered. Assisting faculty with policies and procedures regarding reserve readings (4.50) was rated highly. Several interviewees also looked to library services to provide guidance on matters of copyright (4.50).

Conclusions and Recommendations

This study tried to identify important library services for successful distance education. From the open-ended questions, different interviewees repeatedly offered a number of concerns. Since these comments were unsolicited and unprompted, these indicate commonly perceived essential needs. As previously stated, several library services deemed important or critical for distant students were identified through the literature review and brainstorming. Most notable of these themes was the overarching philosophy that library services for distant students should be comparable or equitable to the services provided to on-campus students (ACRL Guidelines, 1997; Lebowitz, 1997). As the Chair of the Middle States Accreditation Association stated, "there can be no real

differences in the quality of library support on or off campus. If the same level of quality is to be maintained, comparable – not necessarily the same – library resources and services are imperative (Lebowitz, 1997)."

User Expectations

A second, and often overlooked, theme emerged that may prove critical to the continued success of library services for distance education, namely customer satisfaction based on user expectations. Libraries perceptions of user expectations often do not coincide with what the users themselves view as important. Based on a 1995 report by Edwards and Bourne, librarians "tend to emphasize empathy, tangibles, and customer/staff relationships. Yet, academic library users tend to attach greater importance to reliability and responsiveness (Cooper & Dempsey, 1998)." In order to be "successful" by user standards, library services will need to fully understand their users and user expectations and to exceed, not just meet, those expectations.

Access

Access to research resources (databases and library catalogs) and to research materials is of primary importance in the process of academic inquiry. Several resources are currently available. Several of these will improve in usability. More will undoubtedly follow. What is important at this stage is for library services to actively market these resources. Students and faculty need to be made aware of the best and most appropriate tools available to them. Faculties in turn need to make students aware of these resources and encourage their use for class assignments.

Delivery of materials

Information obtained on what materials are available to distant students and how they can be delivered is conflicting and somewhat confusing. Clear policies and procedures need to be established and disseminated so students will know what they are entitled to, what options are available for getting these materials, and how quickly they can expect them.

Instruction

Students will continue to seek assistance from librarians at the last minute. Flexible options for interaction and just-in-time instruction will need to be offered, particularly through phone contact and online options. However, students need to be made aware of the library services available to them, who to contact, and how to use library resources. The most effective way of exposing IST online students to the library service available to them is by inviting the Distributed Education librarian to give a presentation during their initial orientation sessions in order to introduce the service, explain the service available, and demonstrate some of the tools they will use fro research. With the intermediated web page to statement what service are available and how to access to the service, students can be remaindered what service are available,. where and how to access later on during the semester.

Help

Several tutorials and guides are currently available on the IU libraries' Web pages. A searchable list of Frequently Asked Questions or equivalent Knowledge Base would also prove helpful. These may help students in getting connected to databases and started in their searches. However, these are geared to a more generic audience and may not answer specific questions IST students may have. The Distributed Education librarian has offered to develop specific help pages that can be geared to individual courses and linked from that course's Web pages. Given the current staffing shortage in her department, this is not a long-term option. A better alternative for IST students would be an intermediate Web site that offers advice for library research and appropriate resources.

Policies & Procedures

In order to avoid confusion and ambiguity, policies and procedures outlining the services provided, including limits on service, procedures, and any costs involved need to be established and made widely available.

Faculty Assistance

The Distributed Education librarian has already begun contacting departments and divisions offering distance education courses to develop rapport and advertise library services for distance learning. Librarians should also offer assistance to faculty developing online courses in order to determine the potential information and research needs of students in these courses. If any courses have an extensive research component, the librarians could be invited to serve as a "visiting faculty" resource sitting in for online courses and offering instruction or individual assistance to students. Reserves need to be addressed, and quickly. The demand is apparent.

Staffing

The current staffing of Distributed Education Library Services is not sufficient. Ashley Vollmer currently works 10-12 hours serving all IUB distance education students. If any significant demand starts to flow in, she will not be able to fulfill all requests in a timely fashion. A full-time staff position is required to adequately research, plan, and build library services. Even though the ACRL Guidelines and other sources recommend that library services for distance education should be funded by the institution in addition to existing library services and not from existing library funds, it appears that the latter is the case at IU. The IU library personnel budget has also

decreased over the past several years, making it necessary for the library to do more with less staff. External funds need to be appropriated to provide sufficient staff to serve DE students.

Implications

Based on all the evidence found in this study, several conclusions and recommendations were drawn. It should be noted that, while this document seeks to identify the library services needed to successfully serve the IST online program, the adoption or implementation of many of these conclusions would need to happen outside of IST. Some of these recommendations may be seen as impractical based on varying circumstances endemic to other offices, nonetheless we offer them based on user perceptions, literature recommendations, and personal observations.

Understanding user needs/expectations is critical if library services are to be considered successful by users. Without a firm understanding of the unique needs, constraints, and idiosyncrasies of distant students, Distributed Education Library Services will not be able to target or otherwise influence user expectations. To achieve this goal, libraries and the IST department should conduct similar surveys on a regular basis. Not only will this provide feedback on the performance of library services and student expectations, but it will also inform students of the services available.

The results of this study can assist policymakers, such as chief academic officers, head librarians, and distance program committees, as well as faculty and students, in making reasonable and informed judgments with regard to the quality of learner support for distance education.

The results obtained from interviews and document analysis will help to guide the decisions for important or critical services and resources to be included in the model. The next section will discuss the methodology that was used to investigate the research questions and to obtain the information that is the basis for identifying important services and the potential needs that should be built into the library model.

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Establishing Partnerships Between Instructional Technology and Teacher Education Departments: A Case Study

Mary B. Shoffner
Christine D. Thomas
Laurie B. Dias
Georgia State University

Abstract

With the current influx of grants and national technology standards, many in Instructional Technology departments that serve teacher education programs wrestle once again with working outside initial certification areas. How can Instructional Technology departments work with teacher education faculty and programs to ensure that novice teachers will be able to meet new standards? Relationships of an increasing cooperative nature are called for. This paper describes a case of IT and teacher education unit cooperation and its results.

Introduction

With the current influx of Preparing Tomorrow's Teachers To Use Technology grants, many in Instructional Technology departments who serve teacher education programs wrestle once again with working outside the initial certification areas. In light of increasing standards and accountability in teacher education programs, not only in technology but also in all content areas, how can Instructional Technology departments work with teacher education faculty and programs to ensure that novice teachers will be able to meet these standards? The technology standards are high and require significant attention in order for new teachers to meet these standards, probably more attention than most teacher education faculty are capable of giving. Experts argue the need for a stand-alone technology course as part of the preservice curriculum to adequately prepare new teachers for new roles versus the modeling of technology integration across the preservice program. While a stand-alone technology course should provide preservice teachers with adequate skills to meet technology standards, university and college administrations are reducing program credit hour requirements to assist students in graduating in a timely manner. Few programs can still afford the credit hours to devote to a stand-alone technology course. Whatever the solution, instructional technology departments are often housed outside of initial certification departments, and face challenges to influence initial certification program curriculum. Relationships of an increasing cooperative nature are called for.

At Georgia State University, the Instructional Technology unit has been working closely with the Middle Childhood Education unit for the past three years to develop just such a cooperative relationship. Working together, the units have re-designed the stand-alone technology course into an innovative, alternative approach to technology in teacher education in which introductory teaching methods are taught in a technology–rich learning environment. In addition, a multi-submission portfolio assessment plan for all Middle Childhood Education students was instituted to ensure that all students meet multiple national standards prior to graduation.

This paper explores the process and the outcomes of this partnership. Current and future plans for the partnership are provided. In addition, the authors provide their personal perceptions why this partnership worked, and continues to grow. Finally, recommendations for establishing partnerships between IT units and initial certification units are provided.

Instructional Technology and Teacher Education

Computer technology has been available for use in educational settings for several decades. According to a survey of state technology officials (Trotter, 1999), 42 states require teacher preparation programs to include technology. One might think that by this time colleges of education (COEs) are successfully preparing teachers to integrate technology into instructional practices. However, this has not necessarily been the case. In 1995, the Office of Technology Assessment (OTA) published a report on the state of teachers and technology. According to the OTA, teachers were not and did not feel adequately prepared to integrate technology into their teaching practices. One of the contributing factors cited was the lack of technology training available in teacher preparation programs at colleges of education (COE). When technology instruction was provided, it involved teaching *about* technology not teaching *with* technology. In most instances, COE faculty did not model technology integration with their preservice students. Willis and Mehlinger (1996) conducted a literature review on technology and teacher education. Their findings concurred with the OTA report:

Most preservice teachers know very little about effective use of technology in education and leaders believe there is a pressing need to increase substantially the amount and quality of instruction teachers receive about technology. The idea may be expressed aggressively, assertively, or in more subtle forms, but the virtually universal conclusion is that teacher education, particularly preservice, is not preparing educators to work in a technology-enriched classroom (p. 978).

According to a recent survey of 416 teacher preparation institutions commissioned by the Milken Exchange of Education Technology, most faculty members did not model the use of instructional technology skills in their teaching (Moursund & Bielefeldt, 1999). In several studies it appears that faculty who are not modeling are also not requiring students to use technology in their lessons or assignments (Lewallen, 1998; U.S. Congress, 1995; Wetzel, 1993).

In a nationwide survey of education majors and faculty, Fulton (1989) found that while 58 percent of the faculty thought that graduates certified in secondary education were well prepared to use technology, only 29 percent of the students felt they were. However, a report produced by the U.S. Department of Education (2000) revealed refreshing news: less experienced teachers were more likely than experienced colleagues to indicate that college course work prepared them to use computers in their classrooms. "84 percent of teachers with 3 or fewer years and 76 percent of teachers with 4 to 9 years of teaching experience reported that college/graduate work prepared them to use these technologies to any extent, compared with 44 percent of teachers with 10 to 19 years and 31 percent of teachers with 20 or more years of teaching experience" (p. 78). While teacher education programs still face obstacles as they prepare preservice teachers, it is evident they are making in-roads.

Models of IT Instruction in Teacher Education Programs

These in-roads are being made via stand-alone computer courses as well as through integrated coverage across teacher education curriculum. Early efforts to infuse technology into teacher education often resulted in a stand-alone course that focused primarily on technology literacy skills. Many of the strategies used were based on a behavioral model in which students focused on learning a prescribed set of skills and were assessed through objective computerized assessments. It was not uncommon for these courses to be taught by technology faculty with little input from education faculty (Willis & Mehlinger, 1996). In this model, teaching and technology are separated. Therefore preservice teachers are not able to integrate technology into their teaching practices.

This model is still used in many COEs. Leh (1999) conducted a study on the content of technology courses offered to education majors at 25 colleges and universities. The study revealed that while all of the courses focused on concepts and skills, only 52 percent taught about curriculum integration. Results of study by Bennett and Daniel (1999) on novice teachers who experienced a stand-alone course indicated that having only a single course in computer technology was not sufficient. It did not adequately prepare teachers to apply technology in the classroom.

A second model of instructional technology instruction in teacher education programs is one in which all teacher education faculty model technology integration across all courses. While ideal in concept, it is arguable that many teacher education faculty still lack sufficient technology skills and access to successfully practice cross-program modeling of technology integration.

In response, some COEs have re-invented the stand-alone course to make it more constructivist in nature with a greater focus on technology integration. Effective teacher education programs combine this course with technology integration in the teacher education courses. In a follow-up study to the OTA report, Wetzel and Strudler (1999) looked at four colleges deemed exemplary in their approaches to prepare inservice teachers to use technology. The study indicated that each of these programs had a required educational technology class for preservice teachers to take early in their program. In addition, each institution was part of a larger plan for preparing students to teach with technology. The Milken Exchange on Education Technology report (1999) calls for increased use of technology in curriculum courses. It too indicated that a single course in instructional technology does not provide adequate training for preservice teachers. This third model, the integrated approach along with a required technology for teachers course, may be the best approach, particularly in light of the renewed focus on accountability in teacher education.

Accountability in Teacher Preparation

There is a national movement towards accountability in teacher preparation programs. New technology standards for teachers along with revised accreditation requirements will require teacher preparation programs to

more closely examine the ability of their new teacher candidates to teach with technology. Recently published National Education Technology Standards for Teachers (NETS-T) (International Society for Technology in Education, 2000) reflect this movement. Along with the standards, the International Society for Technology in Education (ISTE) has created "professional preparation performance profiles." These profiles provide scenarios for the types of activities that teacher preparation programs can expect from their students at four phases of professional development from general preparation through their first year teaching. This publication is timely and comes on the heel of a call-to-action to the COEs by the National Council for Accreditation of Teacher Education (NCATE).

In 1997, NCATE concluded that a majority of teacher education programs were not doing what needed to be done in terms of preparing teachers to teach in the 21st century classrooms. NCATE recommended that its accreditation body recognize technology education for teachers as central to the teacher preparation process. As a result, NCATE raised the bar. Aligned with Interstate New Teacher Assessment and Support Consortium (INTASC) standards, the newest NCATE unit standards now require teacher candidates to be able to "appropriately and effectively integrate technology and information literacy in instruction to support student learning" (2000, p. 8).

States are also calling for accountability. In our state of Georgia, the Board of Regents of the University System of Georgia has adopted *Guiding Principles on Teacher Preparation* (*USG News: Principles on Teacher Preparation Approved*, April, 1998). This policy " 'guarantees' the performance of P-12 teachers prepared through [the University System's] teacher education programs for teachers who are teaching within the fields for which they have been prepared" (p.1). Under the guarantee principle, "the University System will 'take back' any teacher within the first two years after graduation from a System institution when a school district in Georgia determines the teacher's performance is less that effective in helping students make satisfactory progress...If taken back, a teacher will receive additional preparation at no cost to the teacher or to the school district" (*USG News: Principles on Teacher Preparation*, March, 1998, p. 1).

In addition, Georgia Governor Roy Barnes appointed an Education Reform Study Commission to look at ways to improve Georgia's schools. The results of the study created the *A Plus Education Reform Act of 2000* , passed into law earlier this year (2000). Out of the act came two technology-related initiatives that impact teachers and teacher preparation programs. First, the act mandates that renewable teaching certificates would not be granted unless the candidate demonstrated "...satisfactory proficiency on a test of oral and written communication skills, <u>a test of computer skill competency</u>, [underline added] and an assessment to demonstrate satisfactory on-the-job performance appropriate to the applicant's field of certification" (p. 65). Second, the act holds teacher preparation programs at universities and colleges responsible for their graduates' technology competencies. Universities and colleges

> shall require students in such programs to be proficient in computer and other instructional technology applications and skills including understanding desktop computers, their applications, integration with teaching and curriculum, and their utilization for individualized instruction and classroom management. There shall be a test to assess the proficiency of students enrolled in teacher preparation programs in computer and other instructional technology applications and skills. (p. 68).

An Alternative Approach: Cooperative Faculty Partnerships

In considering how to best address these accountability issues, Georgia State University explored alternative approaches to technology instruction as well as how IT faculty might be involved in preservice programs. The development of this alternative approach was made possible by a collaborative partnership established between the Instructional Technology unit and the Middle Childhood Education unit. This partnership was developed in an effort to redesign the initial certification programs at GSU to meet changing course offering calendars as well as the call for increased accountability in teacher education by professional associations and accrediting agencies. Other universities have also examined the potential of collaborative partnerships between instructional technology and initial certification programs. Duffield's (1997) account of an instructional technology–teacher education partnership at University of Colorado-Denver chronicles a four-year journey in which Duffield served as an IT consultant to the elementary methods team. What is telling is that more partnerships haven't been cited. Perhaps the answer to this can be found in examining how colleges of education are typically structured. Instructional technology programs teach to a more diverse audience than do initial certification programs, and as such, often have difficulty fitting in to the typical college of education structure. Historically, IT programs have developed from two theoretical foundations, audio-visual/media, and corporate training, design, and development; programs which focus on a broader than K-12 audience. Because of this diverse, non K-12 heritage, many universities have difficulty placing IT programs within their departmental structure. The simple solution is to set the IT unit as its own

department. While this solution does allow the IT unit a good deal of autonomy, it does have its drawbacks, particularly when everyone else in the college has a K-12 focus. Barriers can go up quickly, and what ensues is a lack of coordination and cooperation between IT and initial preparation programs. The other popular solution, housing IT with other broader than K-12 programs such as curriculum and instruction, educational psychology, or educational leadership departments, has also not been conducive to fostering partnerships with programs that offer initial K-12 teacher certification. It is possible that this division, however convenient it might be for the IT training persona, might be partially responsible for the lag in technology integration in the schools and in our preservice programs. At Georgia State University, initial certification programs fall under the jurisdiction of the Professional Education Faculty, a combination of faculty of the College of Education and the College of Arts and Sciences. The IT unit was moved several years ago to the comfortable umbrella of the largest department in the College of Education, Middle/Secondary Education and Instructional Technology (MSIT). The MSIT department prepares teachers in a variety of traditional and alternative programs for certification in Middle Childhood Education (grades 4-8) and Secondary Education (grades 9-12). Although the IT unit was housed within an initial preparation department, for several years, the IT unit continued to address the broad IT audience, and until 1997, served an approximate 80% corporate audience. It was at this same time that several factors were developing to force a change not only in the focus of the IT unit, but also of the MSIT department.

Program Performance Analysis and Formative Evaluation

In the mid- and late-1990s, several national organizations introduced and promoted standards for preservice teachers and their programs (Interstate New Teacher Assessment & Support Consortium principles, International Society for Technology in Education Technology Standards for All Teachers, as well as content specific standards). At the same time, the University System of Georgia Board of Regents determined that all institutions would move from a quarter to semester calendar beginning with the 1998-99 academic year. The USG Board of Regents guarantee principle mentioned earlier, as well as pending NCATE and APACE (university-wide Academic Programs and Continuing Education self-study) reviews, precipitated the entire MSIT department to participate in a program performance analysis and formative evaluation. In examining all programs, a culture of cooperation between the IT unit and the teacher preparation programs was established.

With an opportunity to revamp the entire Middle Childhood Education program, a Middle Childhood Committee (MCC) was formed. This committee was composed of faculty representing all areas of study for the Middle Childhood Education program: language and literacy, mathematics, science, social studies, reading, and instructional technology. The MCC examined all required guidelines for initial preparation programs at the state and national levels. Input from faculty and student evaluations and surveys were also incorporated into the analysis. All components of the middle childhood undergraduate program were analyzed: program admissions and exit criteria, course offerings, course experiences, field experiences, scheduling of classes, scheduling of student-cohort groups and faculty teams. As a result, major program changes were implemented. This paper focuses on two outcomes of this cooperative relationship which effected how the IT unit prepared and advised preservice teachers and interacted with the initial preparation programs: the redesign of the stand-alone technology course to a technology-methods course and the establishment of a standards-based alternative assessment process for all prospective middle grades teachers.

Technology-Methods Course Development

As indicated earlier, many teacher education programs focused on either a stand-alone course, or on a model of technology infused throughout all teacher preparation courses. Some schools, including GSU, have opted to do both. Kovalchick (1997) offers, "An approach that I have found useful is to blend elements from both a competency based models and integrative models into a reflexive approach in which students use technology as both learner and teacher. In this way, preservice teacher education students are challenged through direct experience to generate personally relevant conceptions of technology" (p. 31). Smaldino and Muffoletto (1997) also promote a combination approach. "Our model attempts to blend the contents of the existing single course with the need to nurture technology applications within methods and other courses. Thus, students first gain an understanding of the applications of technology in education in the broad sense, with an in-depth examination of how technology supports learning in specific content areas" (p.37).

Prior to 1997, the technology course at GSU was a stand-alone, skills-based course that focused on the use of technology as a teacher tool. Content included such technology usage as word processing, mail merging a letter home to parents, and using a spreadsheet program to calculate grades. Little to no learning theory or instructional methods were included in the lab-based course. In addition, the technologies covered were basic in nature –

telecommunications coverage consisted of e-mail, and in later years, the Internet as a database of lesson plans. As pedagogy played virtually no role in the course, students were allowed to substitute a passing grade on a pencil and paper competency test.

In 1997, at the request of the Middle Childhood Committee, the standard skills-based preservice technology course underwent a major redesign. In the first year, the course refocused from teacher-resource-based, skills-based to a technology-integration-into-the-curriculum approach. This refocus was done in part to address a potential cause of low technology adoption in preservice teachers: deficiencies in technology-integration methods (Leggett & Persichitte, 1998).

In fall semester 1998, the IT unit worked with the MCC to redesign the course to further situate the course content in teaching methods. While maintaining a lecture/lab approach, a WWW-based, resource-based learning environment (RBLE) was introduced as part of the course (Hill, 1999; Shoffner, 1999). The course, and its related resource laden WWW site, incorporates a problem-centered, activity-based approach where the computer applications are anchored in authentic and familiar contexts in which teaching and learning occurs (Cognition and Technology Group at Vanderbilt, 1991; Vygotsky, 1978). This approach is based on the view of an open learning environment in which learners have direct input on the direction of the course based on their needs (Hannafin, 1999; Hannafin, Hall, Land, & Hill, 1994). In navigating through the environment and tackling challenges, it is proposed that students will also develop self-directed learning skills, which will serve them well as they enter the teaching profession. Along with confidence in using the technology, self-directed learning skills have been identified as a characteristic of successful technology-using teachers (Shoffner, 1996). The RBLE can be accessed at http://msit.gsu.edu/IT/3210/index.html

At the same time, the course serves as an introductory teaching methods course, introducing preservice students to such concepts as instructional objectives, lesson planning, evaluation, and assessment. The course offers more than teaching the basic ADDIE instructional design model as a way to develop lesson plans while teaching about technology integration skills. In the *Technology for Teachers* course at GSU, the technology is immersed in learning about what being a teacher entails – briefly, planning, learning theory, instructional strategies, classroom management, and assessment. Our hope is that by introducing the technology and the methods together, early in the program, that a) students will forever forward view technology as natural to the learning process as the textbook and the pencil; and b) both the technology *and* the methods will be reinforced throughout their other courses at GSU. One way in which continuity and reinforcement occurs is in the use of portfolios for assessment. In the *Technology for Teachers* course, preservice students generate a portfolio documenting the design of technology-supported instructional environment that facilitates student learning through the design and development of student-centered learning activities. The use of portfolio development and assessment continues throughout the remainder of Middle Childhood Education program of study.

MCE Standards Based Alternative Assessment

A second outcome of the MCC was the establishment of a continuous process of portfolio development and assessment for all students. In response to the Board of Regents guarantee principle, increasing accountability in teacher preparation programs, and the Middle Childhood Committee's recommendation to strengthen the preservice teachers' overall professional development, the committee recommended that the program include an exit assessment that examined the student's ability to apply what they learned in all their courses in some cohesive manner. After examining several assessment models, both traditional and alternative, a portfolio development process with benchmarks throughout the program and final submission as an exit requirement was adopted.

Although most skills and concepts are developed in individual courses, it is important that preservice teachers have command of these concepts and skills with knowledge of how to integrate these concepts and skills into all aspects of teaching. Therefore, a major goal of portfolio requirement was to develop the preservice students' ability to integrate several components of the program across all courses and to develop knowledge and skills in applying these components in all aspects of teaching. Among key skills and concepts under discussion were: integrating technology, developing and implementing lesson plans and assessment strategies, developing and implementing a classroom management plan, working with diverse learners, developing as reflective practitioners, and so on. After a review of the principles of the Interstate New Teacher Assessment and Support Consortium (INTASC), the committee agreed that the principles of INTASC encompassed and addressed all major components of the middle childhood program and could be used to facilitate the development of the preservice teachers. Thus the committee established portfolio guidelines that focused on the ten principles of INTASC. The INTASC Principles are included below.

Principle 1	The teacher understands the central concepts, tools of inquiry, and structure of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.
Principle 2	The teacher understands show children learn and develop and can provide learning opportunities that support their intellectual, social, and personal development.
Principle 3	The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.
Principle 4	The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.
Principle 5	The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.
Principle 6	The teacher uses knowledge of effective verbal, nonverbal, and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom.
Principle 7	The teacher plans instruction based on knowledge of subject matter, students, the community, and curriculum goals.
Principle 8	The teacher understands and uses formal and informal assessment strategies to ensure the continuous intellectual, social, and physical development of the learner.
Principle 9	The teacher is a reflective practitioner who continually evaluates the effects of his or her choices and actions on others (students, parents, and other professionals in the learning community), and who actively seeks out opportunities to grow professionally.
Principle 10	The teacher fosters relationships with school colleagues, parents, and agencies in the larger community to support students' learning and well-being.

Table 1: Interstate New Teacher Assessment and Support Consortium Principles (Council of Chief State School Officers, 1999)

Through the continuous collaboration of the middle childhood committee, guidelines for portfolio development were documented, benchmarks were established, implementation procedures were outlined, and an assessment instrument and procedures were designed. The committee reviewed course syllabi for all MCE undergraduate education courses to determine which INTASC principles were met in each course. The principles were aligned with the program's schedule of course sequence and experiences to establish which principles the preservice students would be able to address at established intervals. These intervals serve as benchmarks to assess the students' portfolios.

The committee decided that the preservice students would write a narrative for each principle and provide artifacts to substantiate their knowledge, growth and experiences in the program. In the narrative, students are required to discuss personal accounts that address all concepts within the principle. In that the student is required to address all concepts of the principle in the narrative, it was clear that a specific artifact might address only one or two concepts within a principle. Therefore the students are required to explain within the narrative how the artifact addresses a specific concept.

The committee established benchmarks based on experiences acquired within the prescribed course sequence. Students are expected to complete all content courses prior to the senior year in the program. The University System of Georgia Board of Regents requires, within a 120-hour semester program, that middle childhood education (MCE) majors have two content areas of concentration -- 12 semester hours in a major area and nine semester hours as a minor area. During the junior and senior years the preservice teachers are immersed in teacher education courses that include field experience components. The INTASC principles and benchmarks were aligned with the Professional Studies and Student Teaching coursework: introduction to middle schools, instructional technology, teaching reading block, topics courses in the content areas, methods block, diversity course and student teaching. The committee established the following schedule as benchmarks for assessing student growth and development in the program. Upon completion of the Professional Studies courses (at the end of the junior year), the MCE students are assessed for meeting INTASC Principles, 1,2,6,7,8, and 9. Prior to entrance to student teaching (midway in the senior year), MCE students submit portfolios demonstrating competency for all ten

principles. Next the committee established a system for portfolio evaluation, introducing the students to the process through seminars and coursework, and assigning faculty advisors to assist students.

Students are guided through the portfolio process. Early in the semester in which students begin Professional Studies course, seminars are delivered by the MCC to introduce the portfolio process to the preservice students. The *MSIT Middle Childhood Education Program Portfolio Evaluation Guide* (Many *et al*, 1998) introduces students to the INTASC principles, and explains the portfolio assembly and evaluation process. The *Converting Your IT 3210 Learning Environment Portfolio To The Junior-Year MCE Program Portfolio Guide* (Shoffner *et al*, 1998) presents strategies for reformatting the Learning Environment Portfolio produced in the *Technology for Teachers* course to the Professional Studies Portfolio.

The portfolio is accepted in a variety of formats. Students may submit an electronic portfolio (on compact disc), a website, or a notebook for faculty review. (The majority of students in program continue to favor the notebook version.) Upon portfolio submission, the MCC meets and collaboratively assesses each portfolio. A simple rubric is used to assess competency in regard to INTASC Principles. Faculty reviewers indicate whether each principle was "not met," "met," or "met in an exceptional manner," and give feedback on the documentation of each principle. Students receiving a score of "not met" on any principle are required to meet with a faculty advisor to discuss what must be accomplished to achieve successful experiences and documentation for the principle.

The portfolio review process was implemented in the fall 1998 semester. Due to the iterative nature of the assessment process, all students met all principles prior to graduation. The portfolios generated by students at the close of their coursework consistently demonstrated a clear understanding of the theoretical underpinnings and application of teaching and learning knowledge. Student narratives provided rich and reflective insight into how each preservice teacher was able to apply what was learned in the college classroom to the middle grades classroom. While students were initially resistant to the added work of compiling the portfolio, by the end of their program, students enthusiastically espoused the benefits of the portfolio process in allowing them to compose a holistic vision of their preparation and educational philosophy, as well as the ability to articulate this vision. Many students comment on the benefits of the portfolio process in preparing them to successfully interview for permanent employment.

Students in the first cohort to complete the portfolio process are now certified educators employed in the schools. Several research-based initiatives are underway to examine their preparedness as inservice teachers. In addition, a study is in progress that will examine the "INTASC" portfolios for the demonstration of technology competencies (NETS-T Profiles). The MCC committee continues to formatively evaluate their program in light of national and state directives, as well as student needs.

Collaboration & Cooperation: Contributing Factors at GSU

The authors would be remiss if we did not reflect on our case study to determine what factors may have contributed to our success, and from that reflection make suggestions on how IT units at other COEs might do the same. Our reflection produced three core factors that contributed to the success of our collaboration: the nature of middle grades, a committed faculty, and a culture of mutual respect within the committee, the department, the college, and the professional education faculty.

It is the nature of those who teach at the middle school level to be cognizant of multiple disciplines as well as flexible. Middle schools typically employ a teaming approach to instruction, where students are assigned to a team of teachers who cover the core subjects. To operate successfully in the team structure, middle school teachers must be flexible and cooperative. This flexibility and cooperativeness must also be present in those who prepare middle school teachers. Furthermore, teacher licensure at the middle grades level is across all content areas. Although preservice teachers prepare in a major and a minor content field, they are licensed to teach all fields, and must be ready to teach in any of the four core content areas and reading. Although it is possible to receive an advanced graduate degree in Middle Childhood Education, most faculty members teaching in our program are from a specialty content area (mathematics, language and literacy, reading, science, social studies, or instructional technology). It is imperative that those who prepare middle grades teachers work together to facilitate this broad multidisciplinary preparation.

A second factor that contributed to the success of the partnership at GSU is the nature of the faculty. Although the faculty differed in their fields of specialty and their experience in the K-12 and college level, all of the faculty involved in the Middle Childhood Committee were committed to making this program work. Georgia State University has a long history of preparing outstanding middle school educators, and the faculty was and is committed to continuing this tradition. The committee met regularly, at times weekly, to plan the program, the technology methods course, and the portfolio assessment process. One reason for the MCC's commitment level was that they were given ownership of the program by a very supportive department administration. Committee members continue to give their time to meet and review portfolio submissions each semester.

The third factor contributing to the partnership's success was the establishment of a culture of mutual respect among the committee members. As committee members come from a variety of disciplines, each had something to bring to the table. Early on, the IT faculty members on the committee were able to establish their credibility as educators. All content areas, including instructional technology, were considered equally important to the preparation of new teachers.

Suggestions For Establishing Partnerships

Although the IT unit at GSU is strategically placed to facilitate such collaborative partnerships, the authors believe that some steps can be taken to nurture such partnerships, even when the IT unit is housed outside the initial preparation programs. We offer the following suggestions to establish cooperative partnerships with teacher education program units.

First, instructional technology faculty members who wish to work with teacher education programs must become familiar with current issues in teacher education preparation and in K-12 schools. As it is possible or even likely that an IT faculty member may not be a certified K-12 teacher, other steps may be taken to develop an understanding of schools. IT faculty members can volunteer to collaborate with a K-12 teacher, designing and team teaching a unit of study. Serving on school technology committees is yet another way IT faculty can develop and understanding of the K-12 school culture.

Second, the IT unit should ideally find a single teacher preparation unit or team that is willing to work with an IT consultant. Many in IT would argue that the integration of technology should take place in a systemic fashion. However, an incremental approach is more likely to be successful, and in this instance, success will likely breed more success. In short, pick a single program with whom to establish a rapport, and then work on establishing a relationship.

To nurture this budding relationship, it is essential that the IT faculty member(s) attend teacher education department or unit meetings. It is at these formal meetings that the IT faculty can establish their credibility as educators by providing information on technology integration strategies while also garnering information about the certifying program. Duffield (1997) concurs, "Probably the most important element of the second year was the time I spent planning and working with the elementary methods team. I was able to become familiar with the content and methods they used and begin discussions about how technology could be integrated into the courses. I also served as an advocate for technology, keeping it part of every discussion" (p. 24). In order to serve as an advocate for technology, IT faculty must stay current with research and methods in instructional technology integration strategies.

Conclusions

Accountability directives for new teacher preparedness are not likely to go away any time soon. Instructional technology preparation will likely continue to be a critical issue in teacher education for many years to come. Instructional technology units can no longer teach only to their corporate training design and development roots. For colleges of education to successfully prepare teachers for the 21st century, instructional technology will need to be more cohesively included in teacher preparation programs. It is imperative that more cooperative partnerships be established between instructional technology units and initial preparation programs. The authors encourage IT units to initiate and nurture these partnerships, making possible more innovative approaches to this important field of study.

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Toward a Post-Modern Agenda in Instructional Technology

David L. Solomon
Wayne State University

Abstract

"Post-modernists look to the past and future equally and position themselves in the present, seeing time as a broken continuum in need of acknowledgement" (Jencks, 1992b, p. 6).

Traditional views in instructional technology are often based upon the application of scientific knowledge. Post-modernism, an alternative paradigm, questions whether science alone offers the best approach to teaching and learning. Post-modernism holds promise for guiding research and development in instructional technology; however, its potential contributions to the field require clarification. Accordingly, cogent definitions of post-modernism have been constructed -- from an instructional technologist's point of view – and implications for the field have been presented to address the concerns of critics. This paper received the 2000 ETR&D Young Scholar Award and the author notes that the term, "post-modern," shall be hyphenated to symbolize "... the continuation of Modernism and its transcendence" (Jencks, 1995, p.30).

Throughout its history, the field of instructional technology has been focused on improving teaching and learning through technology (Ely, 1999; Saettler, 1990). Over the years, various interpretations of the word, "technology," have been at the root of inquiry and debate in our field. As a result, traditional and alternative approaches to theory development and practice have emerged. A traditional interpretation of technology is the systematic application of science (Clark & Estes, 1998) which emphasizes the utilization of scientific knowledge and principles (Seels & Richey, 1994). Grounded in the behavioral sciences, traditional approaches to instructional technology share common values including the use of precision-based methods, measurement, replicability, predictability and order (Gustafson & Tillman, 1991; Jonassen et al., 1997; Seels & Richey, 1994). Alternative perspectives in our field assume a broader interpretation of technology as the systematic application of *all* sources of organized knowledge (e.g., literature, science, the arts), suggesting that art, craft and science all have roles to play in instructional technology (Davies, 1981/1991; Richey, 1995; Seels, 1995). Whereas traditional views in our field rely solely upon scientific knowledge, post-modernism, an alternative paradigm, questions whether or not science alone offers the best path (Wilson, 1997a). Within the past 10 years, post-modern perspectives in instructional technology have been receiving greater attention within the Association for Educational Communication and Technology (Wilson, 1997a). In addition, a growing number of publications in the field have begun to define a post-modern agenda. While the *Handbook of Research for Educational Communications and Technology* (Jonassen, 1996) included postmodern theory as a foundation for research in our field, the post-modern agenda remains unclear. Agenda-building is a process through which problems or issues receive professional attention (Richey, 1997). Within this agenda-building framework, ideas that influence professional communities are aligned with the broader agendas of the field (Richey, 1997). Therefore, communication is an important part of the support building process, particularly in theory development (Richey, 1997). Post-modernism offers alternative perspectives on the theory and practice of instructional technology; however, agenda status in our field will never be achieved until communication can be facilitated. There are two major impediments to building a post-modern agenda in instructional technology: First, a widely accepted definition of post-modernism does not exist. Second, the implications for theory construction are unclear (perhaps a consequence of poor definition). Therefore, the purpose of this paper is to construct an integrative and cogent definition of post-modernism that will initiate dialogue among professionals in our field. There are several inherent challenges to accomplishing this goal. Since post-modern discourse is mostly abstract and obscure, it becomes necessary to simplify subject matter and render it less complex for our professional community. This reductionistic process is fundamentally opposed to post-modern principles. In addition, this paper summarizes the literature that has been written about post-modernism across a variety of disciplines; and, while it is always important to see the tip of an iceberg while navigating through uncharted territories, we must also acknowledge the presence of something that has far greater depth.

Part One of this paper will address several issues impacting the definition of post-modernism. Part Two will construct a cogent definition of post-modernism that will promote communication within the field; and, Part Three will explore the potential contributions of post-modern concepts in instructional technology. Despite the challenges, this paper was written with the hopes of taking a step forward in the support-building process.

Part One: Issues Impacting the Definition

One major source of confusion regarding post-modernism has been the elusive language of post-modern discourse. Walter Truett Anderson (1995b) offers the following insight into this dilemma:

> The postmodern era has given the world some really good ideas and some really bad writing. From Derrida on down to humble troopers in the trenches of academia, a style that has come to prevail among postmodernists is one of endless complexification and obscurity. The general idea seems to be that the surest way to establish yourself as a profound thinker is to make it very difficult for anybody to understand what your are saying (p. 92).

Many critics are disturbed by the conventional language of post-modern discourse, including Hooks (1995), who asserts that "as a discursive practice it is dominated primarily by the voices of white male intellectuals and/or academic elites who speak to and about one another with coded familiarity" (p. 118).

In addition, the term "post-modern" is represented in various ways in the literature. The phrase is spelled post-Modern when it refers to a historical epoch (Jencks, 1992a). Literary criticism often styles it as postmodern; and, " ...in architecture and as a cultural event it is usually Post-Modern (to indicate a doubly-coded movement)" (Jencks, 1992a, p. 16). Jencks (1995) hyphenates the term to reflect "...that paradoxical dualism, or double coding, which its hybrid name entails: the continuation of Modernism and its transcendence" (p. 30). Toulmin (1985) offers additional insight into the term:

> We must reconcile ourselves to a paradoxical-sounding thought: namely, the thought that *we no longer live in the "modern" world.* The "modern" world is now a thing of the past. Our own natural science today is no longer "modern" science. Instead ... it is rapidly engaged in becoming "post-modern" science: the science of the "postmodern" world, of "postnationalist" politics and "postindustrial" society – the world that has not yet discovered how to define itself in terms of what it *is,* but only in terms of what it has *just-now ceased to be* (p. 254).

Toulmin's logic may explain some of the ambiguity associated with post-modernism because the term specifies a departure point, but leaves the final destination open-ended (Jencks, 1992a).

Post-Modernism is Evolving

Any attempt to define post-modernism is a daunting task for several reasons. First, the post-modern agenda continues to evolve and is ever-changing (Jencks, 1992a). Next, post-modern thought includes contributions from many areas including philosophy, literature, the sciences and the arts (Doll, 1993; Jencks, 1992b); and, perhaps as a result, the word "post-modernism" means different things to different people (Anderson, 1995b). Jencks (1992a) suggests that there are various post-modern movements (e.g., feminism, the green and ecological movement, libertarian theology) which contribute to the overall sense of confusion surrounding post-modernism. Added to these layers of complexity are various *types* of post-modernism: Skeptical post-modernism and affirmative post-modernism (Rosenau, 1995). Skeptical post-modernism is pessimistic, negative and gloomy, suggesting "... that the post-modern age is one of fragmentation, disintegration, malaise, meaninglessness, a vagueness or even absence of moral parameters and societal chaos" (Rosenau, 1995, p. 108). Within our field, Wilson (1997a) has observed that "...postmodern thinking can lead to ... positive or negative outlooks on life" (p. 303). Although affirmative post-modernism tends to agree with the skeptical view of modernity (Rosenau, 1995), it offers "...a more hopeful, optimistic view of the post-modern age" (p. 108). Rosenau (1995) posits that "many affirmatives argue that certain value choices are superior to others, a line of reasoning that would incur the disapproval of the skeptical post-modernists" (p. 109). Further, there are extreme and moderate versions of both types of post-modernism (Rosenau, 1995).

These divergent expositions of post-modernism are a major source of confusion, which complicates any attempts at definition. This paper will consider various explanations of post-modernism and then suggest a new definition that addresses the concerns of critics.

Post-Modernism as a Philosophical Orientation

It is critically important to distinguish between philosophy and theory because post-modernism is often described as a theory (Yeaman, 1996) when it is actually a philosophical orientation (Wilson, 1997a). First, philosophy is interpreted as a composite statement of beliefs and values from which personal purpose and direction are derived (Ely, 1970). Second, philosophy is a foundation for theory (Koetting, 1996; Smith & Ragan, 1999; Snelbecker, 1974). In contrast, a formal theory consists of hypotheses, propositions, and laws (Richey, 1986). Further, a theory is an organized set of related propositions that enable people to explain, predict or control events (Hoover, 1995; Richey, 1986).

Given these definitions, post-modernism is a philosophical orientation because it does not possess any predictive power. Similarly, constructivism, which has many roots in post-modern philosophies (Wilson, Teslow, & Osman-Jouchoux, 1995), is often viewed as an educational philosophy because it does not have the explanatory power of psychological learning theories (Lebow, 1995; Smith & Ragan, 1999).

The Role of Philosophy in Instructional Technology is Ill-Defined

Philosophy is important in our field because it serves as a foundation for theory (Koetting, 1996; Smith & Ragan, 1999; Snelbecker, 1974). For example, Ertmer and Newby (1993) traced the origins of behaviorism, cognitivism and constructivism back to their philosophical foundations in empiricism and rationalism. The roots of any science can be traced back to philosophical origins (Koetting, 1996; Luiz, 1982; Snelbecker, 1974).

In addition, one's theoretical framework is influenced by one's philosophical orientation to the world (Koetting, 1996). For example, behavioral theory is rooted in empiricism, a philosophical view that knowledge is derived from experience (Schunk, 1991). Accordingly, someone who accepts the notion of empiricism may be more inclined to explain learning from a behavioral orientation. While it may seem odd that behaviorism can be discussed alongside post-modernism, the point to be made is that one's philosophical orientation provides insight into one's values, which exert influence over one's perceptions of the relevance of research (Richey, 1998). Philosophical orientation also serve as a screening device that mediates decision-making processes (Luiz, 1982). Recent perspectives on the role of philosophy suggest that applied "fields of study, such as instructional design, do not have educational philosophies; people who study in these fields do" (Smith & Ragan, 1999, p. 14). For these reasons, it becomes increasingly important to explore philosophy because instructional technology is an applied, decision-oriented field (Reigeluth, 1983).

Philosophy is important for other reasons, as well. Philosophical inquiry cultivates the intellectual skills of critical thinking and offers new perspectives on solving problems (Morris, 1999). James D. Finn (1953/1996) believed that our body of systematic theory needed to be constantly expanded by research and *thinking* (emphasis added). Finn believed in vigorously exploring our ideas about instructional technology; in particular, he felt that philosophizing played a critical role in future planning (McBeath, 1972). Ely (1970) felt "...that there should be a philosophy of instructional technology and that it should vary from individual to individual" (p. 81). Still, philosophical inquiry has been relatively absent from the instructional technology literature (Koetting & Januszewski, 1991). In an update to his 1970 article, *Toward a Philosophy of Instructional Technology*, Ely (1999) reminds us that philosophies change in response to social conditions. Ely (1999) suggests that "...if there is any new dimension to the philosophy held by many professionals in the field it is change itself – the readiness to consider, test and adopt new procedures and processes in the goal of obtaining more efficient and effective learning" (Ely, 1999). As with Jim Finn, philosophy plays a critical role in future planning for Ely, as well.

The emergence of post-modernist and constructivist orientations in the field are beginning to spur renewed interest in philosophical inquiry. In 1992, Hylnka, presented a paper titled "Toward a philosophy of educational technology" to the AECT Definitions Committee and concluded that "any philosophy which can help us to illuminate what we do, how we do it, and why we do it, is worth our time and our effort" (Hlynka, 1992, p. 4). Posing questions is the fundamental task of philosophy, which is the basis for research and the foundation upon which our field is built (Koetting, 1996).

Part Two: Toward a Definition of Post-Modernism

Thus far, post-modernism has been defined as a philosophical orientation; however, its relevance to instructional technology requires clarification. In an effort to promote clarity, post-modernism requires further definition, beyond the domain of philosophy. An interdisciplinary review of the literature suggests that post-modernism is approached from multiple perspectives, including a general social condition (Harvey, 1990; Jencks, 1992b; Lyotard, 1979/1984), an intellectual movement (Doll, 1993) and as an historical epoch (Jencks, 1995). Anderson (1995a) believes that "...it's useful to make a distinction between postmodernity and postmodernism – the first being the time (or condition) in which we find ourselves, the second being the various schools and movements it has produced" (pp. 6-7). This perspective offers guidance for constructing a definition of post-modernism. In order to promote clarity, this paper will explore post-modernism as both a general social condition, and as an intellectual movement.

The Post-Modern Condition

As with most post-modern concepts, there are multiple views regarding the condition of postmodernity. Harvey (1990) proposes that postmodernity is a pervasive condition that follows the breakdown of the "Enlightenment project," a great historical era where rational thought and the scientific method replaced superstition and tradition. According to Harvey (1990), "the Enlightenment project ... took it as axiomatic that there was only one possible answer to any question. From this perspective it followed that the world could be controlled and rationally ordered if we could only picture and represent it rightly" (p. 27). Many definitions of the post-modern condition can be linked to the French philosopher, Jean-Francois Lyotard. In 1979 Lyotard authored *The Postmodern Condition: A Report on Knowledge,* upon request by the Council of Universities of the Québec government. In Lyotard's (1979/1984) report on the state of knowledge in the Western world, he asserted "... that all modern systems of knowledge, including science, had been supported by some 'metanarrative' or 'grand discourse' about the main direction of history" (Anderson, 1995a, p. 4). Anderson's explanation is among the most lucid: "A metanarrative is a *story* of mythic proportions, a story big enough and meaningful enough to pull together philosophy and research and politics and art, relate them to one another, and – above all – give them a unifying sense of direction" (p. 4). Simply put, Lyotard's (1979/1984) definition of postmodernity is "...incredulity toward metanarratives" (p. xxiv). Jencks (1992a) offers another view that contrasts both the negative and positive attributes of the post-modern condition:

> The increase in communication (and the information glut and advertisement), the growth of knowledge (and the consumer society), the rise of leisure (and of Disneyland simulacra), the flowering of Post-Fordism (and the insecurity of workers), the emergence of a new world order (and the *Pax Americana),* the EC, GATT and global economy (and the Third World debt and IMF riots) – for every positive post-modern trend there is a corresponding negative consequence. (p. 13)

Perhaps unknowingly, Gustafson (1995) provided one of the best descriptions of the post-modern condition, as it relates specifically to the field of IT:

> Rapid changes in world economic conditions are creating enormous pressures on business and industry to become more competitive and help their employees become more productive. Coupled with these pressures are the demands of ever-changing technology and the information explosion. In the past, workers could "train and then apply" what they had learned. Today the question is increasingly, how can employees "learn while applying?" The world is moving so fast that knowledge can become obsolete even before it can be analyzed, developed into training programs, and offered to employees. (p. 24)

For the purpose of defining post-modernism as a general social condition, a synthesis of these various perspectives reveals a set of common themes: globalization, rapid change in the information age and concern for (multicultural) people. Simply put, the post-modern condition refers to the milieu that currently exists in our world, today. Gustafson offers one perspective of the post-modern condition as it relates to instructional technology. Ely's (1999) concept of a "philosophy of change" is; yet, another.

The Post-Modern Intellectual Movement

The section that follows serves to illustrate that the roots of post-modernism can be traced through a variety of disciplines. In order to improve communication in instructional technology and facilitate theory construction, the elusive language of post-modern discourse is conspicuously absent. An abridged version of the post-modern intellectual movement has been constructed in order to identify the sources of post-modern thought. The author respectfully acknowledges that each of the foundations of the post-modern intellectual movement is an area of inquiry unto itself: (1) structuralism, (2) semiotics, (3) poststructuralism, (4) deconstruction, (5) knowledge and power, (6) critical theory, and (7) self-concept.

Structuralism.

Appignanesi and his colleagues (1995) suggest that "postmodern theory is a consequence of this century's obsession with language" (p. 56). Accordingly, post-modernism has its roots in structuralism (Appignanesi et al., 1995), which is "...an intellectual movement most readily associated with the linguist Ferdinand de Saussure and the anthropologist Claude Levi-Strauss" (Bush, 1995, p. 2). Structuralism asserts that the meaning of language (and culture) can be derived from its underlying formal systems (Bush). A central premise of structuralism was the existence of "...a systemic 'center' that organized and sustained an entire structure" (Bush p. 2). Structuralism is concerned with "... underlying rules and conventions that enable language to operate...the social and collective dimension of language [and] the infrastructure of language common to all speakers on an unconscious level" (Appignanesi et al., p. 57). Saussure also proposed that within a language system, the signifier (the word) carried

meaning, and the signified (the concept) was that to which it refers (Appignanesi et al., 1995). Together, a signifier and the signified are a sign and meaning is derived through their relationship, which is socially constructed.

Scheel and Branch (1993) suggest that "...conversation may serve as a basis for designing and implementing culturally pluralistic instruction" (p. 13) because the goals of instruction and the goals of conversation are similar. Both attempt to focus on common topics and create shared meaning, which address some of the concerns of structuralism.

Semiotics.

Semiotics is the science of signs and sign systems and their relationships to language and human behavior (Morris, 1946). Further insight into semiotics is offered by Appignanesi and his colleagues (1995):

> Saussure opened the way to analyzing **culture** itself as a system of signs by proposing that structural linguistics was part of semiology, a general science of signs which studies the various systems of **cultural conventions** which enable human actions to signify meaning and hence **become** signs.

Semiotics is clearly rooted in structuralism, which declares that meaning is founded on a system of shared conventions (or is socially constructed). While the obvious application of semiotics in our field would address message design, a body of literature in the humanities offers unique perspectives on the implications of post-modern thought in instructional technology. In particular, Jay David Bolter (1991) has explored the notion of electronic writing spaces, claiming that the computer is a self-contained system where the entire process of semiosis occurs. Bolter reminds us that in electronic spaces, people learn to read and write differently, interacting with text that is now a texture of signs that include words and graphic elements. Michael Joyce (1995), an acclaimed hypertext novelist, explores technology in relation to new forms of art, instruction, teaching and writing. Joyce addresses the nomadic movement of ideas, enabled through the electronic medium, and he challenges current conceptions of human capabilities. These ideas have implications for the various ways in which meaning can be constructed and/or facilitated through technology and instructional design processes.

Poststructuralism.

Poststructuralism attacks the structuralist notion of a systemic "center" – the underlying rules of a social system – that organizes and sustains language and culture (Bush, 1995). Poststructuralist critics argue that language lacks a central organizing structure, and is inherently unstable and ambiguous (Bush, 1995). Bush (1995) suggests that poststructuralism generally includes three main features: (1) The primacy of theory, (2) the decentering of the subject, and (3) the fundamental importance of the reader. These features are explained in the following paragraphs.

The primacy of theory. Bush (1995) suggests that poststructural criticism is laden with theory, the nature of which challenges and subverts the enduring assumptions and beliefs of western civilization. As a consequence, "...poststructural criticism has been associated with an adversarial stance that often takes on the established institutional and political forces in American society" (Bush, 1995, p. 2).

The decentering of the subject. Contrary to humanistic ideologies, "... the poststructural subject or self is seen to be incoherent, disunified, and in effect 'decentered ...' (Bush, 1995, p. 2). Steiner Kvale (1995) offers further insight:

> The focus on language implies a decentralization of the subject. The self no longer uses language to express itself; rather the language speaks through the person. The individual self becomes a medium for the culture and its language (p. 22).

People are seen as "commentators" who convey "unconscious mainstream ideologies" or as transmitters of "various cultural constructs ... created by the structures of power in a given social environment..." (Bush, 1995, p. 2).

The fundamental importance of the reader. Bush (1995) states that "with the destabilizing or decentering of the author and in more general terms of language as a system, the reader or interpreter has become the focal point of much more poststructural theorizing" (p. 2). Essentially, this tenet posits that readers create their own meanings, regardless of the author's intentions.

Poststructural thinking in instructional technology would encourage an examination of the relationships among the designer/developer (author), the learner (reader) and the use of language in instructional systems. This type of inquiry, like Rowland's (1993) concept of "reflection-in-action," views design as a reflective conversation with the materials of the situation (Schon, as cited in Rowland, 1993). The goal of this type of intelligent activity is not a fixed understanding; but, rather a more integrative awareness of the various ways in which instructional technology can be used to help learners create their own meanings or facilitate meaning that is more closely aligned with the designer/developer's intentions. Discourse analysis is another poststructural technique for revealing systems of thought that "... operate at a linguistic level to produce and regulate knowledge" (De Vaney & Butler, 1996, p. 5). In their examination of early educational technology texts, De Vaney and Butler (1996) employed a rhetorical technique that explored the hierarchy of topics and subject matter as represented in the table of contents and indices. In addition, the authors' intentions were investigated in prefaces and forewards; and, these findings

were then related to discourse-specific systems of thought. The value of this mode of inquiry was an illustration of the systems of thought that have shaped the production of knowledge in our field and the influences that these discourses continue to exert in instructional technology, today.

Deconstruction.

Deconstruction is an offshoot of poststructural theory that was introduced by the philosopher Jacques Derrida. Hlynka and Yeaman (1992) offer a summary of the basic tenets of deconstruction in their ERIC Digest titled *Postmodern Educational Psychology:*

1. Consider concepts, ideas and objects as texts. Textual meanings are open to interpretation.
2. Look for binary oppositions in those texts. Some usual oppositions are good/bad, progress/tradition, science/myth, love/hate, man/woman, and truth/fiction.
3. "Deconstruct" the text by showing how the oppositions are not necessarily true.
4. Identify texts which are absent, groups who are not represented and omissions, which may or may not be deliberate, but are important (pp. 1-2).

One of the assumptions of deconstruction is that virtually any facet of cultural life can be interpreted as a text and subsequently deconstructed (Harvey, 1990). In instructional technology, deconstruction can shed light upon the process of interpretation and lend support to the constructivist notion that learners construct knowledge rather than acquire it. By reducing texts to a play of signs, the goal of deconstruction is to show that perfect signification between a sign and its referent can never exist; thus, an insistence on the endless quality of interpretation (Bolter, 1991).

Knowledge and Power.

The French philosopher, Michel Foucault is the postmodern theorist recognized for addressing the concerns of power and legitimation (Appignanesi et al., 1995). Appignanesi and his colleagues provide a concise summary of Foucault's perspective: "he tackles power from the unusual angle of **knowledge** as systems of thought which become controlling, that is, socially legitimated and institutional" (p. 82). Lyotard (1979/1984) has expressed similar views; he presents knowledge as a commodity, he questions who will have access to it, and, he raises questions about its legitimation.

Knowledge is seen as the most important resource and learning the most important capability for businesses today (Zack, 1999). Knowledge management, which is concerned with "...recognizing, documenting, and distributing explicit and tacit knowledge ..." (Rossett, 1999, p. 64), can be linked to analysis activities in instructional technology. While knowledge management isn't intended to replace training, Rossett (1999) reminds us that we have access to more information than ever before and our challenge as instructional technologists is integrative. Not only should instruction incorporate data from diverse knowledge bases, it should also complement intellectual capital.

Critical Theory.

Critical Theory emerged out of the Frankfurt School, a German philosophical and sociological movement that generally believes that scientific inquiry is riddled with non-theoretical interests because theory development is a product of social processes (Honderich, 1995). Critical theory promotes a radical change in theory and practice, encouraging that every one-sided doctrine should be subjected to criticism. In his book, *Knowledge and Human Interests,* Habermas (1971) advanced the notion of critical theory, which situates knowledge within a philosophical framework based upon three forms of valid inquiry, which produce three forms of valid knowledge (information, interpretations and analyses). Just as post-modernism means different things to different people, alternative definitions of critical theory have emerged in the literature. Anderson (1995a) states that "in literature and the arts, we have critical theorists who insist that when you experience a work of art you don't simply take in the artist's intention, but actively participate in creating whatever meaning or message you find" (p. 9).

In 1983, Koetting (1983) explored the notion of knowledge in instructional technology and developed an epistemological framework for inquiry in our field. Koetting's paper, "Philosophical Foundations of Instructional Technology," (1983) discussed the implications for future research, and, proposed alternative philosophical and theoretical frameworks for inquiry within the field. While an exploration of Koetting's (1983) work is beyond the scope of this paper, the point is that "... the field should embrace a wide variety of research paradigms ..." (Driscoll, 1991, p. 310). Koetting's (1983) paper may be one of the first works to directly relate critical theory to the field of instructional technology (Nichols & Allen-Brown, 1996).

Self concept.

Jacques Lacan, the French psychoanalyst, proclaimed that the unconscious is structured as a language, and that thinking was dependent upon language (Appignanesi et al., 1995). With its roots in psychoanalytic theory, post-modern assumptions about self concept posit that individual identity is "... constructed (and frequently reconstructed) out of many cultural sources" (Anderson, 1995a, p. 10).

The natural connection between self concept and instructional technology would be a refined exploration of learner characteristics. Anderson (1995a) posits that

> ...the postmodern individual is a member of many communities and networks, a participant in many discourses, an audience to messages from everybody and everywhere – messages that present conflicting ideals and norms and images of the world (p. 9).

This notion suggests the importance of considering more variables that could potentially affect learning and instruction. The implication is that knowledge of the "many communities and networks" to which learners belong, may yield strategies for improving the efficacy of instruction.

General Assumptions About Post-Modernism

Post-modernism has been defined as a philosophical orientation, a social condition and as an intellectual movement. In support of the latter definition, the foundations of the intellectual movement were outlined; however, the definition is still incomplete. Doll (1993) cautions that "... it is impossible to give one overarching definition of post-modernism: The movement is too new to define itself and too varied and dichotomous for any one branch to be representative" (p. 5). In response to the question: "What is post-modernism?", Jencks (1995) proclaims that "...its continual growth and movement mean that no definitive answer is possible – at least not until it stops moving" (p. 29).

Given these challenges, I have constructed eight general assumptions about post-modernism from an interdisciplinary review of the literature. The assumptions about post-modernism follow for consideration, discussion, and/or adoption. Clearly, this is not an exhaustive list and many more assumptions about post-modernism are sure to exist. The underlying purpose for constructing these assumptions is to synthesize a large body of information and summarize the post-modern ideology.

Post-Modern Assumptions

1. Pluralism. An essential *goal* of post-modernism is to promote pluralism (Jencks, 1992a). Jencks believes that "...pluralism is the leading 'ism' of post-modernity ... [and it] means the end of a single world view and, by extension, a 'war on totality', a resistance to single explanations, a respect for difference and a celebration of the regional, local and particular" (p. 11). The concept of pluralism is pervasive throughout the post-modern intellectual movement as evidenced by Hlynka and Yeaman's (1992) proclamation that "...if there are multiple ways of knowing then there must be multiple truths" (p. 3).

Pluralism can be seen as an underlying philosophy in instructional technology that allows various perspectives to co-exist. For example, a post-modern worldview would suggest that researchers should not yield to dominant research paradigms. Practitioners would celebrate a type of theoretical pluralism where traditional and non-traditional approaches to learning and instruction could complement each other.

2. Eclecticism. An essential *style* of post-modernism is eclecticism (Jencks, 1992b). According to Jencks (1995), "post-modernism is fundamentally the eclectic mixture of any tradition with that of the immediate past" (p. 27). According to Harvey (1990), "Derrida considers ... collage/montage as the primary form of postmodern discourse [i.e., painting, writing, architecture]" (p. 51) because it produces a signification that is "neither univocal nor stable."

As a style, eclecticism shares the pluralistic philosophy described above; however, in instructional technology it might become manifested as the combination of models to produce viable instruction (Richey, 1995). Instructional technology is an eclectic field, in and of itself, where ideas and resources from other disciplines become integrated into our theoretical and practical bases of knowledge.

3. Knowledge. An essential *tenet* of post-modernism is that people construct knowledge (Wilson et al., 1995). Although the concept that knowledge is constructed rather than acquired is not necessarily a post-modern invention, it clearly positions the post-modern stance on the constructivist side of the fence. As previously discussed, constructivism has many roots in post-modern philosophies (Wilson et al., 1995). While this assumption about knowledge is seemingly innocuous, it is laden with several post-modern issues. From Lyotard (1979/1984), one of the defining characteristics of post-modernism is a disbelief in metanarratives, or established knowledge (a concept that is also linked to pluralism because it rejects single explanations). Lyotard (1979/1984) also promoted the idea that "knowledge is and will be produced in order to be sold, it is and will be consumed in order to be valorized in a new production: in both cases, the goal is exchange" (p. 4). Lyotard's perspective appears visionary in light of contemporary issues surrounding knowledge management. Yeaman (1996) believes that "separating the author from the authority of a text requires acknowledging the political issues of knowledge and power" (p. 276), an idea that is related to post-modern assumptions about truth.

4. Truth. An essential *opinion* of post-modern thinking is that truth is grounded in subjective experience (Wilson et al., 1995). In addressing the question of where truth lies, Hlynka (1996) explains that "traditionally, one assumes that the author of a work is the ultimate authority ... [however] 'truth now lies in the text itself, while the new task becomes one of interpretation" (p. 256). Further, Hlynka illustrates how contemporary literary theory and reader response theory suggest that "...authority lies not only in the author who wrote it, or in the text that says it, but in the reader who reads it" (p. 256). The French sociologist, Jean Baudrillard, advanced the notion of the simulacrum, which occurs when the distinction between representation (e.g., art; signs) and reality breaks down, marking the absence of a basic reality (Appignanesi et al., 1995). Baudrillard's conclusion relates to the notion of truth (albeit an extreme form of postmodernism); and, his ideas remain an important part of the movement's intellectual history. A more common opinion is offered by the philosopher, Richard Rorty (as cited in Anderson, 1995a), who posits that "truth is made rather than found (p. 8);" a view that interprets reality as being socially constructed.

As with the assumption about knowledge, these ideas about the nature of truth are reminiscent of constructivist ideas in instructional technology. In particular, meaning is understood to be rooted in experience, which supports the argument for situating learning activities in authentic environments (Duffy & Jonassen, 1992). In this regard, authority or truth would reside not only in the learning environment and materials, but also with the learner.

5. Language. An essential *theme* of postmodern thought is that language is deeply involved in the social construction of reality (Anderson, 1995a). From a poststructuralist perspective, Weedon (as cited in Anderson & Damarin, 1996) suggests that "language enables people to think, speak and give meaning to the world around them" (p. 270). Further clarification about language is offered by Anderson and Damarin (1996) who state that "how people write, talk, and otherwise communicate about what they know, do, and believe reflects the ways they are shaped by particular discourse communities" (p. 270). An underlying, poststructural issue associated with the role of language is that meaning is indeterminate because language is inherently unstable and ambiguous (Bush, 1995).

Scheel and Branch (1993) have reviewed the benefits of focusing on common topics and creating shared meaning through dialogue. Another concept of learning is based upon hermeneutic principles that views learning as a process of interpretation (Jonassen et al., 1997). While the instructional designer can use language that increases the probability of "correct" interpretation, Jonassen and his colleagues (1997) also explain how hermeneutics can be used in instructional design to assist with personal interpretation. Although seemingly simplistic, discussion questions at the beginning of a lesson can be used purposefully to stimulate the development of subjective meaning (Jonassen et al., 1997).

6. Communication. An essential *issue* in post-modernism is communication (Harvey, 1990). Transmission models of communication typically include a sender who encodes a message, the message, a channel; and, a receiver who decodes information (Shannon & Weaver, 1949). Additional components of the model usually include noise and feedback. Communication is a foundational issue in post-modernism because each component (and every element) in the communications process is scrutinized. Post-modern assumptions, as presented here, posit that authority lies not only in the sender and the message, but also in the receiver. They also address post-modern questions of knowledge, power and legitimation as they relate to the information source and the message. Finally, with respect to noise and feedback, the post-modern concerns about communication are also entwined with post-modern sciences of complexity, described below.

7. Complexity. Jencks (1992a) describes a post-modern science as shifting "... from fairly inanimate matter (planets and physical objects) to living systems (social groups as well as individuals) (p. 15)." As an example, Jencks (1992a) points to a view of nature as a self-organizing system. From this perspective, systems are interpreted as dynamic, living entities which consist of non-linear processes and a high degree of feedback, which characterize all life (Jencks, 1992a). An applied example of this concept could be Artificial Intelligence, complex computer systems that are designed to adapt to environmental stimuli. Chaos methodology is another application that "... shifts emphasis from relationships of cause and effect to more interactive, multivariant approaches that stress the importance of defining patterns, form, self-organization, and adaptive qualities of complex processes" (Krippner & Winkler, 1995, p. 166).

A post-modern interpretation of chaos theory would jettison the notion of deterministic predictability and posit that chaos is inherent in all systems; thus, explaining the irregular behavior of nonlinear dynamic systems. The implications of this orientation would be an examination of the myriad variables that interact to produce learning and "developing metacognitive awareness in learners as a way of helping them deal with a complex and ill-structured world" (Jonassen et al., 1997, p. 32). There may also be implications for understanding the role of human emotion as a strategy for managing chaos in learning, as well (Jonassen et al., 1997).

8. Self. Post-modernism interprets an individual as a pluralistic person with a disappearing self. Anderson (1995b) states that "the postmodern person is a *multi-community* person, and his or her life as a social being is based on adjusting to shifting contexts and being true to divergent – and occasionally conflicting – commitments" (p. 128). Further, Anderson (1995b) posits that "individuals negotiate (and renegotiate) personal identity, struggling to make internal peace among the multiple components of their selves and the claims of the different communities to which they are connected" (p. 128). Gergen, (1995) a leading exponent of post-modern psychology, challenges traditional assumptions about human development as "...a single, basic self to which we can be true" (p. 137) in favor of the idea that people carry the potential for many selves which can be realized in various social settings (Anderson, 1995b).

These ideas are opposed to beliefs about the importance of establishing a strong, integrated sense of personal identity, which paints a one-dimensional picture of the learner. While there may be central tendencies related to the concept of self, post-modernists would argue that we have paid to much attention to them and have ignored the complexity of human existence (Gergen, 1995). In our field, the concept of self reminds us that instructional design needs to address more than practical issues and provide for the human spirit (Keller, 1979)

Part Three: Potential Contributions of Post-Modern Concepts in Instructional Technology

The eight general assumptions just reviewed demonstrate the depth and range of post-modern thought. Together, they represent a body of ideas that could define a post-modern philosophical orientation; however, these assumptions are still difficult to relate to the field of instructional technology. Accordingly, the following section will summarize several core concepts about post-modernism, from which potential contributions to the field of instructional technology can be discussed. The core concepts that define a post-modern philosophy of instructional technology include:

1. The philosophical "core" of post-modern instructional technology is a belief in pluralism, which can be described as respect for difference and a resistance to single explanations.
2. Knowledge, truth and reality are constructed by people and groups of people.
3. Criticism is an appropriate method for inquiry in instructional technology.
4. Systems are interpreted as highly complex entities with adaptive qualities.

The philosophical "core" of post-modern instructional technology is a belief in pluralism, which can be described as respect for difference and a resistance to single explanations. As a defining characteristic of post-modernism, pluralism is a concept that has pervasive and far-reaching impact in instructional technology. At the surface, pluralism means that multiple perspectives may be valid and that there is no single best way to develop instruction (Davies, 1981/1991; Hlynka & Yeaman, 1992). Similarly, pluralism in our field would posit that there is no single best model or theory of learning. From an applied perspective, pluralism could be seen as an eclectic approach where multiple views of content, strategies and perspectives are offered (Wilson et al., 1995); however, this is still a surface view of the concept.

Beneath the surface; however, the concept of pluralism runs deeper. The issues of integration that affect the field (Seels, 1995) could be guided by post-modern philosophy, particularly with respect to "the integration of knowledge from the arts with knowledge from the sciences in an age of technology" (p. 252). Post-modernism accepts the idea that art, craft and science could co-exist in instructional technology. While diverse views of the art, craft and science debate continue to emerge in the literature (see Clark & Estes, 1998; Braden, 1996; Merrill, Drake, Lacy, Pratt, & ID2 Research Group, 1996; Davies, 1981/1991), post-modernism celebrates these multiple perspectives.

The implications of pluralism in relation to research and the needs of practitioners are also far-reaching. For example, the notion of the learner as a pluralistic person, situated in contexts that are continuously shifting, suggests the need to consider a multiplicity of variables related to learner characteristics and ecological systems (see Bronfenbrenner, 1979; 1988), all of which influence learning and instruction. Another example concerns alternative research methods that are emerging in the literature including multiple interpretations of data and self-reflexive technique, the recognition of one's own values in the research process (Anderson & Damarin, 1996). These examples provide a framework for conceptualizing the implications of pluralism in instructional technology. The fundamental concept of pluralism is that multiple perspectives are valid, an ideology that can be applied to various facets of the theory and practice of instructional technology.

Knowledge, truth and reality are constructed by people and groups of people. *As a foundation for constructivism (Wilson et al., 1995), post-modern philosophies of knowledge, truth and reality are exerting great influence on the field. Post-modernists believe that knowledge is something that is created rather than found, which is mirrored in constructivist ideas about cognition (i.e., people create meaning through experience as opposed to*

acquiring it). The concepts of subjective truth and socially constructed reality are also beliefs that constructivism and post-modernism share. Together, the concepts of knowledge, truth and reality have helped to mold and shape the emerging theory base for constructivism, including agenda-building around specific issues such as situated and collaborative learning.

The philosophical view that reality is socially constructed can provide a framework for addressing issues surrounding cultural diversity. For example, Scheel and Branch (1993) have offered strategies for designing culturally pluralistic instruction based upon the premise that one's cultural background will influence interactions between the learner, content, teacher, media and context. Recognizing that learners are culturally inscribed and relational to the societal context, they believe that language and conversation can be used strategically to promote cultural pluralism and increase the potential for learner achievement. These ideas can be directly linked to diverse theories of language that provide a foundation for the post-modern intellectual movement discussed earlier.

Criticism is an appropriate method for inquiry in instructional technology. Scientific and critical perspectives can be complementary in the field of instructional technology (Wilson, 1997b). For example, a scientific approach in our field would pose research questions that require predictions and hypotheses while a critical perspective is more like literary or film criticism, exploring various layers of meaning. These approaches can be integrated and work together because,

> Science and technology, if not checked, would tend to see things in terms of their instrumental value, in terms of their scientific classifications. Criticism, most skillfully practiced by the postmodern theorists, brings balance to the picture by closely examining the details. Technology alone tends to be problem-driven and goal-based. Most attention goes to whether objectives are achieved. Criticism looks beyond the objectives to examine the unintended side effects, the secondary meanings, the shades of gray (Wilson, 1997b, p. 25).

While criticism should not become an exclusive method of inquiry, its value in instructional technology is still misunderstood. The rationale for criticism is summarized by Belland and his colleagues (1991): "as a field which draws knowledge and practice from a wide range of arts and sciences, educational technology should be able to use a variety of ways of investigating and knowing in order to guide inquiry and practice" (p. 151).

Systems are interpreted as highly complex entities with adaptive qualities. While the humanities provide a major source of post-modern thought (Hlynka & Yeaman, 1992), post-modern science interprets systems as highly complex entities with adaptive qualities (Jencks, 1992a). Although the growing base of literature that addresses post-modern instructional technology has not yet explicated the implications of post-modern science, the concept of highly complex systems has received some attention in the field (see You, 1993). As learning and education become increasingly more complex in our knowledge-based society (Trilling & Hood, 1999) the concept of complex systems could offer a philosophical perspective to guide future inquiry. For example, the post-modern concept of complexity could offer insight into research on flexible learning systems that keep pace with rapid changes in organizational structures, processes and information technology (a by-product of the post-modern condition discussed earlier). Accordingly, a post-modern philosophical orientation might support the need for contextual analysis which broadens the number of variables that designers consider during the design of instructional systems (Tessmer & Richey, 1997).

Conclusion

This paper has attempted to illustrate the relevance of post-modernism in the field of Instructional Technology. In pursuit of this goal, post-modernism was defined as a philosophy, social condition and an intellectual movement. As a philosophical orientation, post-modernism values multiple perspectives and the contextual construction of meaning (Wilson, 1997a). The post-modern condition describes a rich and diverse milieu that is influenced by globalization, rapid change in the information age and multiculturalism. As an intellectual movement, post-modernism is deeply rooted in theories of language and various disciplines including the arts, sciences and humanities. As an eclectic field, instructional technology integrates ideas from a variety of disciplines, which may help to explain the emergence of post-modern thought within the discipline. Seels (1989) describes the field as the confluence of three disciplines, including media in education, psychology of instruction and systematic approaches to education. Richey (1986) has outlined four theoretical foundations of the field: communications theory, general systems theory, learning theory and instructional/curriculum theory. Given these broad perspectives on the origins of instructional technology, the roots of post-modernism (e.g., semiotics, psychology, theories of language) can be linked to our history and should not be ignored.

The voices of our founders and the early discourses of the field have established a valuable role for philosophical inquiry in instructional technology; however, the path was never very clear. And, with post-modernism, there are multiple paths that diffuse meaning. Based upon an interdisciplinary review of the literature,

this paper has explored the sources of confusion surrounding post-modernism. Next, three definitions of post-modernism were proposed (i.e., a philosophy, a social condition and an intellectual movement). Then, the potential contributions for the field were discussed, all in order to promote communication within the field and facilitate an agenda-building process around post-modern issues.

Post-modernism holds promise for guiding research and development in instructional technology. The diversity of theories and concepts in our field, many of which have been borrowed from other disciplines, are often broadly organized around three distinct areas of inquiry such as behaviorism, cognitivism and constructivism (Ertmer & Newby, 1993). Accordingly, the theoretical perspectives in our field do not always enrich each other because research is often aligned with a particular orientation. While there is recognition that no single theoretical perspective can completely explain learning (Snelbecker, 1989; Smith & Ragan, 1993), the potential relationships between differing views could lead to stronger theories, a promise that could be realized through an affirmative orientation to post-modernism.

Finn (1962/1996) believed that technology was "... a way of thinking about certain classes of problems and their solutions" (p. 48). Post-modernism offers a way to think about thinking. It may not be everyone's "cup of tea," but our field can be enriched by exploring alternative views. At the very least, post-modernism challenges us to understand our own beliefs and recognize how our values are represented in everything that we do.

Biography

David L. Solomon is completing his dissertation in the Instructional Technology program at Wayne State University. In addition to teaching college students at the secondary and post-secondary level, he has more than 13 years experience designing, developing and implementing instruction and performance improvement solutions for multinational and privately held businesses (he can be reached at writechange@wwnet.net).

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The Effect of Anchored vs. Direct Instruction on Students' Learning Basic Geographical Concepts

Ilhan Varank
Ilhan Kaya
Florida State University

Abstract

The purpose of this study is to compare direct instruction with anchored instruction based on students' learning performances and attitudes (n=100) in teaching basic geographical concepts in an introductory undergraduate level course. Direct instruction students will attend their regular lecture-based class sessions. Anchored Instruction students will design a lesson to teach the basic geographical concepts. It is expected that students in the both groups will perform equally on the performance posttest and the students in the anchored instruction group will score better than the ones in the direct instruction group on the attitude questionnaire.

The Effect of Anchored vs. Direct Instruction on Students' Learning Basic Geographical Concepts

In recent years, the effectiveness of direct instruction and anchored instruction has been a hot debate subject among researchers. When comparing with other instructional settings the researchers supporting the constructivist notion advocate that learning significantly occurs and is efficiently transferred through anchored instruction. Students also maintain more positive attitudes towards the instruction (CTGV, 1992). On the contrary some research reveals similar findings for direct instruction (Shuman, 1999; Bergin & Walworth, 1999)

Anchored instruction is a teaching paradigm which advocates that some subjects can be taught in the context of a situation in which that subject is applicable. The purpose of employing an anchored instruction model is to create interesting, realistic contexts through technology or other means that encourage the active construction of knowledge by learners instead of learning just facts and principles (Bransford et all., 1990; Fen at all., 1997).

Anchored instruction is based on situated learning and focuses on problem solving. Situated learning is a general theory of knowledge acquisition, promoting the idea that knowledge needs to be presented in an authentic context and that learning requires social interaction and collaboration. Authentic contexts provide an opportunity for students to experience the problems or immerse in the phenomena being investigated to produce knowledge and solutions similar to the ones experts do. Moreover, the learners within authentic environments are able to develop mental models of their authentic experiences for positive learning transfer (CTGV, 1990, 1992).

Direct instruction, a behaviorist or instructivist approach in teaching and learning, is based on the notion that learning can be facilitated through clear instructional presentations which rule out likely misinterpretations and facilitate generalizations. Also, direct instruction focuses on teaching and practicing sub skills and sub-knowledge that allow students to advance to higher-order skills (Kozloff et all, 1999; Direct Instruction, 1999). As a teaching strategy, direct instruction, on the other hand, is a systematic and highly structured instructional process that leads students to master in an extremely efficient manner (DiGhiera, 1998). Some key components of this process are scripted lesson plan that is evaluated and revised, curriculum designed to build new skills on previously learned ones and small-group sessions where teacher and students interact. (Direct Instruction, 1999).

Geography education lacks of empirical research that might provide guidelines for practitioners to evaluate alternative teaching and learning strategies (Downs, 1994). Very few studies investigated the effectiveness of different instructional techniques in terms of students' attitudes and learning performance. Nordstrom (1996) compared three instructional approaches, a traditional lecture-based direct instructional approach, a hybrid half-lecture half-collaborative approach and a fully collaborative approach, to teach an undergraduate environmental management course. Based on the students' evaluations of the course, he found that "the students view collaborative approach as a viable alternative to more traditional approach". On the other hand, another study comparing traditional lecture approach with cooperative learning to teach an introductory geography class by Hertzog and Lieble (1996) revealed the result that there was no significant difference between the two approaches based on the students' posttest performance results. Additionally, students in the lecture group and cooperative group exhibited similar attitudes towards both teaching techniques (the mean attitude scores were 2.9 and 2.8, consecutively)

The purpose of this study is to compare direct instruction with anchored instruction based on the students' learning performances and attitudes in teaching basic geographical concepts in an introductory undergraduate level course to provide practitioners with empirical data on alternative geography teaching and learning strategies. Based

on the literature review above, it is expected that the students in both groups will perform equally on the posttest. The students in the anchored instruction group will score better than the ones in the direct instruction group on the attitude questionnaire

Method

Subjects

The subjects in this study are 100 undergraduate freshmen and sophomore students enrolled in four sections of an introductory geography course at a university in the northeast Florida. Each section has 25 students and the gender breakdown is 60% male and 40% female. Two of the sections are randomly assigned to the direct instruction group and the other two groups are assigned to the anchored instruction group. The participation in the experiment is considered a course requirement, but the assessment results are not considered a part of the course grades.

Instructional Materials

There are no specific instructional materials to be used during the study. For the direct instruction intervention, the direct instruction group will attend their regular lecture-based class sessions, and the instructors will use their regular class notes and handouts to teach the basic geographical concepts, such as the definition of geography, places and regions, physical systems, human systems, environment and society, etc. For the anchored instruction intervention, the students in the anchored instruction group will be given a scenario in which they will be asked to design a lesson based on a template to teach the basic geographical concepts. The template is the one taught in the introductory educational technology course at the university. The lesson plan template requires students to consider and specify instructional goals and objectives, instructional materials to be used during the instruction, learner level and learner characteristics, instructional procedure including motivating students, helping students recall prerequisites, presenting information, providing practice and feedback, and student assessment with the actual assessment tool. The students will be free to use all the resources to design the lesson, including the Internet and the class textbook as well as other textbooks.

Independent Variables

The independent variables in the study are the types of instructional procedures: Direct instruction and anchored instruction.

Direct instruction.

Direct instruction will be used to provide students with direct information through a lecture to teach the basic geographical concepts.

Anchored instruction.

Anchored instruction is designed to provide a contextualized learning environment where the students are put in an instructor role and required to design a lesson plan on basic geographical concepts to teach in an actual classroom setting.

Dependent measures

There are two types of dependent measures in this study: Students' learning performance scores and students' attitude questionnaire scores at the end of each instruction. Students' learning performance will be measured by a multiple-choice performance test that has 50 items. Students' attitudes towards the instructional procedures will be measured by Keller's 34-item Course Interest Survey (Keller, 1995) based on students' attention, relevance, confidence and satisfaction. Both performance test and Course Interest Survey have high reliability and validity.

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What Cultural Studies Can Teach Us About Educational Technology Research: Theory Into Practice

Rick Voithofer
Ohio State University

Abstract

This paper describes the background to the problem and methodology of a study that explored a reflective new media pedagogy through the design and production of a web-based learning environment. This environment addresses and invites cancer patients and their supporters to question established social and cultural discourses that shape the experiences of cancer by inviting visitors to create ways to talk about cancer that more closely relate to the uniqueness of their lives and to the characteristics of the disease. Through a collaborative approach to educational media design involving an educational media designer and cancer patients and their supporters, a web site (http://www.cancershock.com) was produced to support cancer patients and their supporters in creating non-linear, flexible discursive spaces for rewriting social and cultural discourses that shape and inform the experience of cancer in Western, industrialized cultures. This interdisciplinary study presents a design practice influenced by cultural studies approaches to new media pedagogy and drawn from the experience of engaging in collaborative and reflective educational new media design.

Introduction

> Seriously ill people are wounded not just in body but in voice. (Frank, 1995, p. xii)
>
> If I were to demystify or deconstruct my cancer, I might find that there is no absolute diagnosis, no single agreed-upon text, but only the interpretation each doctor and each patient makes. (Broyard, 1992, p. 21)
>
> The most disorienting challenge to traditional thinking posed by developments in the postmodern era is the perception that illness is no longer a purely biological state – no longer a brute force of nature – but rather something in part created or interpenetrated by culture. (Morris, 1998, p. 70)

This paper describes the background to the problem and methodology of a study that explored a reflective new media pedagogy through the design and production of a web-based learning environment. This interdisciplinary study presents a design practice influenced by cultural studies approaches to new media pedagogy and drawn from the experience of engaging in collaborative and reflective educational new media design. It uses the design, production, and revision of a web site, http://www.cancershock.com (hereafter referred to as "CancerShock"), as an educational intervention to study the educational possibilities presented by a culturally informed new media pedagogy. CancerShock acts on behalf of cancer patients and their supporters to reframe notions of health, health care, and disease in ways that, compared to choices presented by traditional Western healthcare practices, are more supportive of the uniqueness of the daily lives of cancer patients and their supporters.

The pedagogy of CancerShock parallels a growing body of thought that calls for rethinking the care of chronic diseases like cancer in ways that have stronger connections to the cultural, subjective uniqueness of a patient's lived experiences (Broyard, 1992; Frank, 1995; Kleinman, 1988; Radley, 1993; Stacey, 1997; Treichler, 1992). This literature often refers to the notion of the "postmodern", (Morris, 1998), "postcolonial" (Frank, 1995) or "participatory" (Stacey, 1997) patient as one who actively creates their own ways (through non-linear personal narratives) of living with the disease versus being positioned by the pre-dominant rational, linear discourses of biomedicine. This study presents a culturally informed collaborative approach to educational technology design that tries to support a cultural intervention in healthcare and support discourses while offering a critique of current educational technology design models.

My critique of dominant forms of educational media design influenced by educational psychology shows an alternative approach that is guided more by theoretical frameworks contained within cultural studies (Grossberg, Nelson & Treichler, 1992) approaches to media study including poststructuralism and feminisms. The methodology of this study structures its inquiry around discursive contextualizations of the social and cultural issues surrounding cancer treatment, as well as, relating how these discourses form and interact with the participant's cultural models

about healthcare. I use those discursive contextualizations to inform my collaborations with audience members in the design and revision of CancerShock.

The design principles that I developed for this study serve as a response to and a critique of traditional educational media design methodologies that seek to create media that deliver just the "right", predictable message to a knowable and definable audience. In other words, I worked with design principles that work under the assumptions that one can never predict the ways that an audience will interpret a media text and that media interpretation occurs at the fluid borders of the audience's subjectivities (Ang, 1996; Fiske, 1989a; Fiske, 1989b) rather than the center of artificially created, essentialized characteristics. These design principles are derived from a reflective practice (Schon, 1983) that continuously works to resist facile descriptions of the audience.

This study is inspired by the lived, currently unfolding, experiences of a friend who is undergoing treatment for ovarian cancer. In the summer of 1998, a friend (who I will call M.) and media collaborator was diagnosed with ovarian cancer. Alienated and angered by her encounters with dominant biomedical discourses and wanting a way to "rewrite" and make sense of her life with cancer, she became interested in reframing her experience from one dominated by the fragmented linearity of her health care to one that supports her fight against a disease that is profoundly non-linear and requires, not fragmentation, but a constantly responsive adjustment and juxtapositioning of scenarios, treatments and interpretations. Her approach to cancer underscores a trend in people's approaches to the treatment of serious diseases in which patients are demanding a greater voice in the treatment process and resisting the silencing and alienating practices of traditional medical discourses (Frank, 1995; Kleinman, 1988; Radley, 1993; Stacey, 1997). The intervention of this study is informed not only by M.'s experiences but also by my collaborations with other people with cancer and their supporters, as well as by emerging discourses currently being constructed by cancer patients about health and disease (Stacey, 1997). This is especially the case in light of current communication technologies like the Internet that allow easy access to information and provide for more opportunities to participate in support communities (Klemm, 1998). Because this study involved collaboration with other cancer patients and various family and friends of cancer patients, this intervention spoke not only to M.'s situation, but to a wider audience of people with cancer and their supports.

CancerShock was created to act as a model and workshop to help people with cancer to reframe their healthcare experiences in ways that resist the binaries that are presented to people with cancer and their supporters. These binaries include sick/healthy, patient/doctor, feeling good/feeling bad – binaries that serve to create static notions of disease and people with disease that allow and disallow specific ways of experiencing oneself with cancer. Through a collaboration with M. and a group of approximately thirty collaborators living with cancer or supporting someone with cancer. I created a social and cultural intervention that problematizes narratives about health, healthcare, disease, and quality of life that are presented to people affected by cancer (Frank, 1995; Kleinman, 1988; Morris, 1998) and rewrites those narratives so that they better support people's fight against cancer and their struggle to maintain particular senses of self and social positionings (Broyard, 1992).

The collaborations were used as a feedback and revisions mechanism for the web site through the use of an action-research oriented approach (Stringer, 1999) to educational media design that seeks to work with members of the intended audience to create the design, structures, and messages of the media. This approach allowed me to be reflective about my role as an educational media designer in ways that are responsive to the multiple subject-positions of educational media audiences. The design and production process included ongoing prototyping and discussions with cancer patients and their supporters.

Within the context of this study, the issues that were addressed revolve around how to use media as an educational tool to trouble and disrupt commonplace narratives and discourses about health and disease and to create new spaces in which to rethink the limiting ways that people talk about cancer. The stories that patients are told by medical professionals and that are implied by the time, space and aesthetics of cancer therapies, hospital rooms, and doctors' offices are the sites of intervention for CancerShock. CancerShock provides a set of activities and tools that offer its visitors (i.e. people with cancer and their supporters) an opportunity to (re)frame and (re)tell stories about fighting cancer.

The questions of this study related strongly to pedagogy and drew parallels between the art of teaching as a social and cultural approach and the science of teaching as an educational psychology approach. I developed a notion of new media pedagogy that is based on the idea of pedagogy as an artistic practice, a component of instructional design often alluded to by traditional cognitive-based theorists but rarely explored. Michael Milano and Diane Ullius in describing their book, *Designing Powerful Training: The Sequential-Iterative Model*, a traditional instructional design book write:

The truth is that designing training is part art, part science; it requires both technique and creativity. The very best training designs exhibit a kind of alchemy, a transformation of content into activities that meet specific behavioral objectives. (Milano and Ullius, 1998)

In this study I began to name the artful parts of pedagogy as they relate to the design of educational new media. My pedagogical goal for this study was to find a new media pedagogy that is artful and therefore attentive to the interaction of emotions, memory, pleasure, desire, aesthetics, representation, and learning. These are all aspects of pedagogy that are considered in a cultural studies approach to pedagogy (Todd, 1997). Sharon Todd (1997) captures this notion:

> Moving away then, from essentialized views of oppression and subjecthood, pedagogy may be rethought as a process that gets tangled up in the nexus of social relations where identifications, fantasy and desire begin to emerge as pressing concerns with the field of the social. (p. 4)

In fact, cultural theorists of medicine have identified desire as the sick person's best medicine (Broyard, 1992). Because qualities such as desire are not easily definable, I explored a pedagogy that resists instrumentalization, an academic practice of containment. I developed a pedagogy for this particular project that acts as one way of approaching educational media design from cultural perspectives.

From a cultural perspective, pedagogy can be seen as invitations into a subject-positions. Therefore the new media pedagogy that I have created in this project is attentive to the subject-positions into which it invited its audience. The interplay between an audience's subject-positions, experiences of their disease and healthcare, and educational media represented important pedagogical moments.

Background to the Problem

Cancer introduces a myriad of complexities into the lives of those it affects. The emotional and physical struggles presented by this disease intersect with the multiple subjectivities of the people it touches. This calls for approaches to educational media design for this audience that have not been adequately considered by traditional approaches guided by cognitive learning theories (Dick & Carey, 1996; Smith & Ragan, 1999).

This project addresses the numerous ways that a person's multiple subjectivities impact efforts to create social interventions with respect to the complex issues raised by the treatment of cancer. For this study, subjectivities will represent the social positions that are offered by discourses centered around race, class, gender, cancer, biomedicine, etc. Subjectivity presents a central theme in a cultural approach to new media design.

An important question that always must be addressed when considering a media intervention such as this is, "Why use media instead of another pedagogical or non-pedagogical intervention?". What is gained and lost in the decision to construct meaning in this manner? This question can be addressed specifically to this project. Part of the answer to this question can found in the trend that more and more individuals are educating themselves about cancer through the Internet (Eysenbach & Diepgen, 1999).

In this study I not only explored using media like the Internet to respond to socially and culturally circulated discourses, but I investigated how a dispersed medium like the Internet broadens the field of discourses in which one becomes inscribed through the subject-positions offered. If traditional biomedical discourses, with their centralized and hierarchical structures, try to create fixed subjectivities, how might the dispersed medium of the Internet create the potential to encounter beliefs and truths which we may never have been encountered? The Internet, as a medium and source of information and communication raises many questions regarding traditional Western, modernist understandings of certainty, binaries, and progress. If the Postmodern critique of modernist notions of progress, objectivity, and binary truths (i.e. sick/healthy) values the world as a continuum (Lyotard, 1984), the Internet as a postmodern process makes such modernist understanding less feasible.

Many people who are faced with cancer use the Internet to research the disease and to communicate with others who confront cancer (Eysenbach, 1999). A search on the Internet for cancer-related sites revealed numerous web sites that reinscribe the rational discourses about cancer that this study works to disrupt. Despite the plethora of information that is available on the Internet about cancer, as Braddock, et al. (1999) found, fewer than ten percent of all patient decisions are well informed. This could be attributed to many factors including poor information, however studies have found that a great deal of the information provided on the Internet is accurate and up-to-date (Kiley, 1998; McLeod, 1998).

It is important to note that much of the medical literature focuses on techniques to evaluate the accuracy of Internet-based cancer information (Biermann, 1999; Gagel, 1999) but none addresses decision making using these techniques. This indicates that while many people are getting information each other about possible treatments they

are not putting this information to the most effective use. Patients and their supporters are not taught what to do with all this information. They are aware of many of their options but are unable to make the most informed medical decisions within those options.

By placing CancerShock within the context of other cancer-related web sites, CancerShock offers an alternative set of perspectives that may begin to provide new contexts to make sense of information about cancer and cancer treatment that is always in flux and changing. The results of this study show that this context could not be discovered/constructed by using traditional forms of educational media design. An innovative form derived through cultural theory was required.

The approach to educational media design that I explored in this study does not recognize educational media design from a strictly scientific perspective in which meaning is seen as being injected by media into audiences (i.e. students) while researchers examine the results of this "treatment." Rather, I explored how educational media designers might acknowledge and work with the ways that media consumption is not only a cognitive experience, but also an embodied and culturally-situated experience that actively engages and invokes memory, history, desire, and senses of time and place (Ang, 1991; Ang, 1996; Fiske,1988; Morley; 1992; Radway, 1984). This approach to educational media design rests on the assumption that the meanings people make as they use media are highly situated within their daily lives and are shaped by their generalized views about the world (Morley, 1986). on the Internet and communicating with

Cultural Models

> The illness narrative is a story the patient tells, and significant others retell, to give coherence to the distinctive events and long-term course of suffering. The plot lines, core metaphors, and rhetorical devices that structure the illness narrative are drawn from cultural and personal models for arranging experiences in meaningful ways and for effectively communicating those meanings. Over the long course of chronic disorder, these model texts shape and even create experience. The personal narrative does merely reflect illness experience, but rather contributes to the experience of symptoms and suffering. (Kleinman, 1988, p.49)

While people respond to media through generalized worldviews (Hall, 1973; Morley, 1980; Morley, 1991) or cultural models, important insights can also be gained by how the knowledge that people construct using media supports, contradicts, and modifies their cultural models. My use of cultural models was influenced by Strauss & Quinn (1997) and Gee (1996). Strauss and Quinn's conception of cultural models tries to understand opinion formation by showing how individuals negotiate attitudes based upon internal schemas that are influenced by social and cultural contexts. These schemas can be identified in the kinds of stories that people tell about their understandings of the world (i.e. disease), therefore I continually drew parallels between cultural models and narratives – the later providing an indication of the former.

Gee calls cultural models, "pictures of simplified worlds in which prototypical events unfold." He notes that people are often unaware of their cultural models and therefore cultural models appear to be "natural" and inevitable even though cultural models vary across social groups and change over time. This "naturalness" can potentially lead to individuals seeing cancer and its treatment in ways that harm cancer patients by preventing them from considering every possible medical, emotional, spiritual, and physical opportunity to fight the disease – or of creating yet unimagined ones.

According to Gee, "They [cultural models] allow us to function in the world with ease, but at the price of stereotypes and routinized thought and perception." Cultural models form the basis of choices and guesses about meaning within particular communities (i.e. healthcare, media production). They always include a conception of what is acceptable and unacceptable to do within that cultural model. For example, when one enters the world of biomedicine to be treated for cancer, one begins to take on the cultural model of a cancer "patient." This causes people to act and speak in certain predictable ways about cancer. As Gee notes, "It's not just what you say, or even just how you say it, it's always who you are and what you're doing when you say it."

Strauss & Quinn's work indicates how people's cultural models interact with each other and how they interact within various contexts. Cultural models vary in both content and form. The process of cultural model interaction can take the form of "integration"; as people modify their cultural models to make them more consistent with each other. They also observe that people are capable of possessing inconsistent cultural models without experiencing a sense of dissonance. For example, someone who is traditionally questioning and skeptical may place more unquestioned faith in a doctor or medical institution. They call the process of maintaining two inconsistent models "compartmentalization." According to Strauss and Quinn, belief systems are partly integrated and partly compartmentalized. Because challenging received narratives about healthcare existed as an important goal of this

study, how the audience integrates and compartmentalize the messages of the media within their cultural models presented a consistent focus of this study.

While I draw on the work of Strauss, Quinn, and Gee to frame cultural models, I also work with postmodern approaches to address how people make sense of texts. Postmodern perspectives that examine the way audiences interpret media texts highlight the paradoxical relationship between a text and the contradictory identities, positions, imperatives, and experiences within the audience (Ellsworth, 1997). This study balanced generalized statements about individual's cultural models while acknowledging that people are not fixed by their cultural models and maintain agency through their multiple and intersecting subjectivities.

Educational Media Design

> The scientism of psychology is motivated by a fear that the world cannot be mastered, i.e. known directly and certainly, with scientific method. What is manifested here is a desire for 'presence' where the world can be know in an unmediated way. The unmediated and therefore certain knowledge is considered possible in principle but, equally, the possibility of presence is thought of as always under threat; a threat whose source ultimately lies in mediation in its various forms. (Usher & Edwards, 1996, p. 56)

Whereas empirical approaches to thinking about the audience of educational media often ask questions that fix the audience's subjectivities and cultural models by addressing them through essentialized descriptions produced by a "learner analysis," culturally informed approaches to inquiry frame media interpretation in terms of an individual's multiple and fluid subjectivities. For example, while a learner analysis is more likely to reveal characteristics about potential audience members including their skill levels and literacies (i.e. reading, math, etc) or attitudes about a particular concept, a culturally informed approach is more likely to problematize notions of "skill" and "literacy," articulating how they are the result of power structures based on race, class, gender, ethnicity etc. A culturally informed approach offers a language of speaking about the audience's attitudes about a particular idea (i.e. healthcare) that could directly address how their subjectivities help to form that attitude.

This approach is presented to counter theories of media design based on educational psychology, an approach which represents the dominant discourse of educational media design and as Usher and Edwards (1996) indicate, is based on notions of certainty and mastery. Traditionally, educational media design has been influenced by cognitive theories (Reigeluth, 1999) that in varying degrees isolate the mind from the social contexts in which a person learns and constructs knowledge. Developments in cognitive psychology have conceded the importance of the social context of learning in the development of "situated cognition" (Brown, 1989). Situated cognition has developed on the assumption that authentic activities (those rooted in the culture and practices of a community) are the most effective activities for developing useable, robust knowledge. While making strides towards a consideration of social and cultural processes, situated cognition still valorizes the individual mind as sense making instrument and does not problematize what is a useable, robust language. For example, it doesn't ask, "knowledge that is usable by whom? to do what? for whose benefit?".

The seemingly neutral manners (i.e. "unbiased" in its treatment of culture, race, class, gender, etc.) that the "learner" is constructed using psychological descriptions impacts the ways that the design process of educational media is carried out, and ultimately in the nature of the materials produced and the methods that are used to assess individuals after undergoing instruction. For example, many instructional design models engage in a "front end analysis" (Dick & Carey, 1996) in which one part of it attempts to summarize the characteristics of the learner based on such items as reading/math levels, test scores, and the results of questionnaires. This front end analysis leads to descriptions of a learner who is targeted with a set of learning objectives that are to be mastered through the activities using the educational media produced. This methodology often leads to essentialized descriptions of the learner and narrow, easily evaluated learning outcomes. This is similar to the way the medical model traditionally treats patients (i.e. based on fixed, observable, and assessable notions).

Despite its aspirations towards objectivity, educational psychology nevertheless represents a subjective treatment of the issues that define it as a field of inquiry. Its definition of individuals as "learners" is based on specific historical antecedents that have become reified over time and institutionalized through social mechanisms. The labels that are applied to groups and individuals in educational psychology carry with them inherent hierarchical power structures that occupy histories. "Student," "learner," "learning," "teacher," "knowledge," "motivation," and "evaluation" all posses situated expectations and constraints, yet such labels are rarely problematized in educational psychology as they are operationalized. This reification and institutionalization has been an important, if unconscious, objective of educational psychology's desire to be considered a "normal" science (Kuhn, 1970).

Practices within this discipline have produced power structures between the learner and those administering (and evaluating) the learning that values certain ways of knowing by specific types of "learners" over others. These epistemologies influence traditional educational media design models because they are biased towards specific instrumental (i.e. memorization-driven, skills based, problem solving, etc) ways of knowing. Measuring and enhancing learner performance has a long history in educational psychology and exists as one of the founding charges of the field beginning in the early 20th century (Danziger, 1990). Educational psychology, through its "scientific" claims of being the defacto authority in measuring learning, has as its primary mission the measurement of success and failure (Danziger, 1990). Educational psychology proposes to measure learning and its effectiveness through technologies that include "deficit models" and "learner motivation".

Deficit models tend to have strong racial, classed, and gendered undertones (McKay & Wong, 1996), yet they are unable to adequately articulate why these "deficits" are structured into a particular educational setting and the complex ways that they intersect within the individual. While extensive literature has been written about pedagogical issues relating to race, ethnicity, class, gender, and sexuality, little of this literature has influenced the theoretical work done in educational media design. This study will work towards bridging this gap. This is not to say that cognitive approaches do not address learning in social settings, however, by their very nature they are unable to adequately theorize educational issues related to the inter-relationships between race, ethnicity, class, nation or gender except to look at these items in terms of quantifiable measures of performance and motivation.

Traditionally, instructional design theorists have looked at "learner motivation" from the perspective of narrowly defined conceptions of motivation. Keller's ARCS model (Keller, 1983) is typical of such an approach that ignores how motivation and satisfaction are culturally dependent (i.e. influenced by cultural models). This study examined learning using media as the result of desire rather than the result of an abstract notion of motivation. Such an approach borrows from theorists who have discussed the relationship between desire, media spectatorship (Bordwell & Thompson, 1997; Fuss, 1992; Mulvey, 1975), and education (Todd, 1997). These ideas are represented in film and television theories of narrative.

Film theory provides insights into this approach by addressing how notions of anticipation, expectation, surprise, desire and voyeurism are meaning making devices for media interpretation (Mayne, 1993). Television theories of narrative, in contrast to film theories, depart from traditional realist narratives that try to construct a self contained, internally consistent world. In a realist narrative everything makes sense within the structure of the narrative, but, of course, this does not always occur in everyday life where many narratives don't end in tidy resolutions. Television, according to Fiske (1988) invites the reader into "producerly" relations with the text, especially in relation to the most common type of television narrative, the serial. Soap operas offer a good example of television narrative that start from a place of disequilibrium and never reach a point of closure. Even series, like situation comedies, that reach a conclusion at the end of each episode, never resolve ongoing conflicts. These ongoing conflicts either exist within character relationships or the situations that they encounter within their settings.

Television theories of narrative offer fractured constructs of narrative due to television's serialization and commercial breaks. This fractured structure creates conceptual spaces for greater variation in interpretation by the reader. Television narrative according to Fiske (1987), "must be able to build into it contradictions that weaken its closure, and fragmentation that denies its unity." These fragmented narratives serve as a more productive model with which to represent the narratives of everyday life with cancer and provide an appropriate model to think about the design of a web-based learning environment such as CancerShock. Such models of narrative can better support a design process that allows for multiple interpretations of media based on a person's multiple social positions.

Mode of Address

The analytical concept of "mode of address" was used throughout this study as a lens with which to examine the social and cultural position(s) media offer to an audience, as well as interrogate a new media pedagogy for the ways that educational media offer meanings and understandings. Mode of address was developed by Althusser (1971) as a way to talk about how discourses (through address) hail people into particular subject-positions – positions that have implications for the way that people can and can't exist in the world.

Ellsworth (1997) develops the idea of mode of address to raise questions about pedagogy and to ask "who does a piece of media (or pedagogy) think you are" in terms of your subjectivities (i.e. race, class, gender, religion, ethnicity, etc). She describes modes of address as the relationship between social aspects of a text (i.e. media text, structure) and the individual experiences of a text (i.e. reader's interpretation, emotional reaction, etc.). While media interpretations are varied, some readings are more likely than others, depending on a media's mode(s) of address, as well as a person's cultural models. Ellsworth develops the parallel between mode of address of media interpretation and the mode of address of pedagogy and argues that, like media texts, all pedagogies miss their audiences/students because what one learns is never exactly what is taught.

The ways that media/pedagogy miss their audience is an important notion for Ellsworth who reasons that the difference between address and interpretation is a productive space for teachers. She makes the claim that this space is a social space, an uncontrollable space that "bears the traces and unpredictable workings of the unconscious" (Ellsworth, 1997, p. 38) and a space that can be put to use by teachers through it's indeterminacy. I build on Ellsworth's work about address to show how the design of educational new media can use a culturally informed design approach that works with this productive space by acknowledging the ways that media audiences are indefinable and educational media interpretations are uncontrollable.

Decisions in media design are based on (often unconscious) assumptions about who the user is in terms of her or his race, class, ethnicity, sexuality and gender and what cultural competencies s/he possesses (Kress, 1999). Users must take up the offered metaphors and structures and negotiate their own meanings. The reader (or in the case of healthcare, the patient), however, is rarely fully aware of who the text (or treatment) thinks s/he is. Often, multiple modes of address occur simultaneously, adding layers of complexity to individual interpretations, confounding the intended logic of a text. These notions of media interpretation borrow from cultural studies approaches to media theory.

Cultural Studies

Cultural studies is a difficult field to define because it is not a traditional academic discipline grounded in a monolithic theoretical foundation. It borrows from literary history, sociology, history, linguistics, semiotics, feminisms, philosophy, anthropology, and psychoanalysis (Grossberg, Nelson and Treichler, 1992). Cultural studies has been adapted to the countries in which it is practiced including the US (Campbell & Kean, 1998) , the UK (Turner, 1996), and Australia (Frow & Morris, 1993). This is significant because an important component of cultural studies is that it defines culture as dynamic and based in local contexts and histories. In addition to being developed in cultural studies programs, it's theories and methods are incorporated into traditional disciplines (and have disrupted the assumptions and practices of entire academic fields) including communication studies, media studies, history, anthropology, sociology, law, medicine, political science and education.

Cultural studies can best be described as an approach to inquiry that focuses on the connection between social relations and meanings and the ways that social divisions are made meaningful. This approach generally has a political intention that seeks to illuminate the subordination of one group under another. In cultural studies the production of knowledge is always seen as either done in the interests of those who hold power or done by those who contest that hold. According to this perspective culture is partially framed as the subordination of non-dominant groups by the interests of dominant groups. In addition, culture is also seen as the resistance to this subordination. Culture, in this context, is therefore revealed as a site of social struggle. This struggle is exposed by cultural studies to show how class, race, gender, and other sources of inequalities are naturalized and represented in forms (often through media) which break the connection between these and political and economic inequalities.

Cultural studies approaches to the study of media representations and media interpretations have developed as a counterpoint to traditional media reception research that look at generalizable "media effects" (Halloran, 1970) (i.e. watching medical shows like ER causes people to have distorted perceptions of healthcare). Instead, cultural studies are more likely to look at the representations of a show like ER and see how people put those representations to use in their day-to-day lives (Morley, 1992). Cultural studies approaches to media reception stress the importance of viewing media in the context of one's day-to-day life.

In order to discuss the methods that I mobilized to develop the design, production and revision of CancerShock, I will now review in greater detail the questions, methods, data sources, results and implications of this study. I'll address the design of the study, as well as describe each phase of the study.

Study Design

The study was divided into three phases: 1) Contextualization 2) Design and Production 3) Collaboration and Revision. The contextualization phase included a literature review that examined the notion of subjectivity in relation to discourse and agency and identified current discourses about disease and healthcare. The literature review included a description of how a culturally informed educational media design approach contrasts to traditional forms of instructional design, especially constructivism. In addition, the contextualization phase explored what kinds of cancer-related web sites are on the Internet and looks at the present discourses surrounding approaches to cancer treatment by patients and supporters through an examination of discussions on Internet mailing lists. The design and production phase included the first iteration of CancerShock as it began the production processes. The collaboration and revision phase included work with individuals fighting cancer and their supporters to revise the site. This final phase used an action research approach to constantly challenge the praxis of the underlying theories of this study. Along with this general account of the study, I will now include a more detailed description of each phase.

Contextualization

The contextualization phase involved finding out what discourses are made available to people on the Internet seeking information and support related to cancer, as well as examining what people talk about (i.e. with what narratives and cultural models do they identify) when using the Internet for communication about cancer. The first question was explored by undergoing a search using five popular search engines (e.g. http://www.altavista.com/) and Internet portals (e.g. http://www.yahoo.com/) searching for the word "cancer." The top 50 sites that the search produced were coded by general categories and summarized. In addition about 25 of the sites (10%) were analyzed for their mode(s) of address. The results provided insight into what was available to people who search for cancer-related information and support on the Internet.

To answer the question about how people use the Internet for support related to cancer, transcripts of four electronic mailing lists were examined for the themes and narratives of cancer addressed by people on the lists. A discourse analysis provided insights into the prevailing ways that people with cancer and their supporters approach cancer treatment. This information was filtered through the literature of cultural critiques of Western medical model discourses. The findings mirrored many of the perspectives presented in the cultural critiques.

This first stage of the study supported the initial hypothesis about the social construction of cancer in Western societies. It sustained the notion that individuals mostly subscribed to the subject-positions and linear, rational approaches to the disease that Western notions of biomedicine offer. This stage also revealed that new narratives were emerging that offered people with cancer opportunities to create and (re)write their own narratives about cancer that countered traditional and alternative medical (i.e. holistic medicine) healthcare discourses. This information proved useful in the design and production of the site by underscoring the importance of narrative in the way that people make sense of cancer.

Design and Production

The second phase of the study included an initial design of the web site based on the findings of the contextualization phase, and also included work with a small group of collaborators including M., her family and friends. A great deal of time during this phase was spent learning the technicalities of administering and creating an interactive, multimedia web site. The technical demands and tradeoffs of creating a web site constrained how one articulates a new media design practice. The first iteration of CancerShock included both videos and animations to support the ideas that emerged from the initial inquiry. This milestone gave way to the final and longest phase of the study.

Collaboration and Revision

Collaboration and revision involved work with thirty individuals who, knowing the goals of the site, were asked to offer feedback on general and/or specific aspects of the site. The collaborators not only provided feedback but also became partners in the production of the site. Because many of the collaborators were found through postings on public cancer-related mailing lists, most of the communication with them occurred through email, however, I was able to find participants locally who allowed me to personally observe them access and use CancerShock. Watching individuals interact with the site proved extremely helpful in improving the usability and interface of CancerShock. In the revision and collaboration phase I received a range of feedback from technical to conceptual to creative.

Conclusions

The key elements that emerged in this study were expressed through a reflective and reflexive design process that emerged in the creation of CancerShock. A new media pedagogy that incorporates a social and cultural sensibility is one that has the capacity to be self-reflexive in its awareness of its mode of address and assumptions and is reflective in its capacity to collaborate with its audience. This collaboration has the potential to move towards responsive media-based pedagogies that not only are able to address their audiences multiply but are also able to represent content and curriculum as fluid and changing. The implications of such an approach to educational technology practice frame educational new media as only one element among many in the fluid intersections of subjectivity, power, representation, and pedagogy that occur while learning. The social and cultural approaches to new media pedagogy that I have articulated, through the design and production process of CancerShock, suggest one way to shift the discourses of educational technology practice away from the language of certainty and predictability towards one that makes uncertainty, contingency, and context productive by attending to the complex social and cultural intersections that occur while learning.

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Facilitating Web-Based Instruction: Formative Research on Improving an Online Undergraduate Business Course

Jenny Wang-Chavez
Rovy Branon
Indiana University

Peter Mikolaj
Indiana State University

Abstract

The purpose of this study was to assist an instructor in facilitating an online course while the class was being offered, and to provide timely interventions for improving the course during the semester. A formative approach was used to help deal with unforeseen issues in implementing the first online course this instructor had offered. Through data analysis of what worked well, what did not work well, and what improvements were needed, issues related to both students and instructor's perception of the class were identified in the findings. From a student perspective, these issues included: online interactions, assessment, and course participation. For the instructor, there were concerns about new pedagogy, technology, and workload. Based on these issues, instructional interventions were suggested and an overall evaluation was conducted through an online survey. The approach adopted, findings identified, and recommendations made in this study will have implications for other instructors and instructional designers, especially those teaching online for the first time.

Introduction

The Web is offering unparalleled opportunities for student access to learning, information and communication, and thus has growing popularity as a primary medium in distance education (Crossman, 1997). Many colleges and universities are racing to move their conventional courses online (McIsaac, 1998; Molenda & Sullivan, 2000). Despite the "virtual land rush" to grab space on the Internet and the excitement of the technology, many issues must be resolved before instruction can be delivered successfully via the Web. This study addressed some of the prominent issues encountered by an instructor offering a face-to-face course online for the first time.

There are many challenges for faculty teaching online for the first time. Using new pedagogical strategies and working with unfamiliar technology can pose some unique difficulties. Often, the only feedback the instructor gets about a course is summative, which merely allows improvement the next time the course is offered. Instead of relying on data gathered at the end of the course, the researchers in this study took a more participative role by collecting data from multiple sources to inform interventions and to deal with issues as they arose.

The purpose of the study was to assist an instructor in facilitating an online course and provide timely interventions for improving the course. This study investigated what worked well, what did not work well, and what could be done to improve or solve the problems. The results of this study describe how formative methodology was used to address pedagogical, technological, and communication concerns in the course. The findings are relevant to instructional designers and instructors involved in web-based distance education.

Web-based instruction

One phenomenon seen in the realm of Distance Education (DE) is the increased use of the Web as a primary delivery system (Crossman, 1997). When the Web was first used as a delivery system, DE was often considered to be traditional correspondence education. Instruction was (and in some cases still is) delivered through pages full of self-instructional text. Interactivity was quite limited (Hirumi & Bermudez, 1996).

A number of case studies have provided some guidelines and heuristics on building WBI. But an extensive literature research of DE survey models in early 1998 revealed that there were no validated models specific to DE (Williams, Paprock, & Covington, 1999). Fitting distance learners' needs still presents a challenge for distance educators given the differences of needs, ages, cultural backgrounds, interests, and educational levels (Willis & Dickinson, 1997). Distance educators and researchers are exploring more theoretical frameworks to guide the planning, design, development, and delivery of Web-based instruction.

Pedagogical issues that arise in WBI include information overload, "lost in hyperspace," feelings of a lack of cohesiveness, and technical problems. Among institutional issues, the amount of time for an instructor to prepare and deliver the course seems to be a one of the biggest concerns (Hill, 1997). While some guidelines have been established on how to facilitate online learning (Eastmond, 1995; Harasim, 1993), there is a scarcity of research studies on implementation and how formative evaluation can help solve unforeseen problems.

Formative Evaluation

Formative evaluation (FE) is a process of collecting empirical data during the developmental stage for revision and improvement of instructional products (Guba & Lincoln, 1985; Weston, McAlpine, & Bordonaro, 1995). The primary goal of FE is to improve the quality of the product being developed so that the desired goals of the product will be met. The evaluation process involves assessment as well as judgment based on the specific information collected from the users (Beyer, 1995). Conventionally, FE has been conducted before implementing the instructional resources or curricula. The authors of this study, however, advocate using FE as an ongoing process in the implementation stage for distance education.

Methodology

Research framework

Given the inexperience of the instructor in online teaching and the novelty of the course delivery system, improvements were needed throughout the course. To ensure the effectiveness of the class, timely interventions were crucial. Due to the nature and purpose of the study, action research was adopted as the framework. The action research framework was used to guide the researchers to understand the problem, develop strategies for solving the problems, and transform them into best practices. The research study involved three cycles of discovery, intervention, and evaluation (Byrant 1996). It was a constant process of observation, reflection, and action (Stringer, 1996). Action research methodology, when used in the context of Instructional Technology, involves an ongoing process of formative evaluation. This approach was used to gather functional feedback by learning from the event as they occurred and promoted positive changes in a timely manner.

Research context

This research study was carried out in an undergraduate business course being offered through a mid-size Midwestern university. The course was offered via Web-based courseware, Blackboard. The courseware was introduced on the campus in the fall of 1999 and was being used for the first time with this class. Fifteen students registered for this class. The majority of them were taking an online class for the first time. The professor had taught face-to-face for over twenty years but this was the first time he had taught the class at a distance. An instructional designer assisted with instructional strategies and technical concerns; however, there were a number of issues that needed to be addressed by using data gathered during the course.

The instructor used Problem-Based Learning to facilitate student-centered, self-directed learning. His plan was to prompt students with real world questions and have groups lead class discussions for the particular topics being addressed. Class activities included individual discussions and small group assignments. Individual activities involved participating in online discussions by answering questions proposed by the instructor. Group activities consisted of primarily mini-cases appropriate to the chapter in the textbook for that particular week. The class was randomly divided into three groups with five students in each group. Students were graded by their performance on two online exams (with multiple choice questions and essay questions), individual online participation, and group project participation.

Participants

The participants for this study included all 15 students enrolled in the course, the instructor, and the instructional designer, who was responsible for instructional and technological support.

Research questions

The focus of this study was to formatively evaluate an undergraduate business course and help the instructor improve the course when it was being offered. The research questions guiding this study included:

- What issues do instructor and students encounter in teaching and taking an online course for the first time?
- How can these issues be resolved in a timely manner to improve a course as it is being offered?
- What recommendations can be offered for instructors teaching an online course for the first time?

Data collection

Observations

Students' postings were observed to determine the general trend of students' participation. Postings included both individual replies to the class discussion questions posted by the instructor and also their discussions as a group member while collaborating with others to complete the group project.

Survey

Two surveys were designed to gather students' feedback about the class. The first survey was administered before the middle of the semester via email. The survey included three general open-ended questions in the email survey: what went well, what problems they encountered, and what suggestions they had for improvement. Nine students out of 15 (60%) responded.

The second survey was developed based on the responses from the first survey. The interventions suggested by the researchers, and the types of interaction in distance education include the following: learner-instructor, learner-learner, learner-content, and learner-technology (Moore, 1989; Hillman et al. 1994). This anonymous, Web-based survey was delivered by using the Assessment Tool in the course site. The survey was consisted of 19 multiple-choice questions and three open-ended questions. Twelve out of 15 students (80%) responded to the survey.

Interviews

The researchers carried out one semi-structured interview at the beginning of the project and two informal phone conversations with the instructor during the semester. The first interview was to obtain information about how the instructor would like to teach this class and what issues he was dealing with. Two informal phone interviews between the middle and the end of semester were to solicit instructor's opinions on the collection of feedback from students and the proposed interventions based on the feedback.

Document study

Email messages sent back and forth between the instructor and the students provided another important source for understanding the issues surrounding this class. Eighty messages archived by the instructor were analyzed.

Data analysis

The data collected from the observations, surveys, interviews, and email messages were triangulated to determine the students' and instructor's perceptions of the class, issues raised throughout the semester, and recommendations for future improvement. Numerical data were tabulated by survey items and corresponding percentage in each item. The data analysis on qualitative data involved an iterative inductive process. The initial data analysis started with reading and rereading email messages and coding the small complete text units into indexed categories. Through iterative induction and constant comparison with categories and data, key issues and themes were generated.

Findings

The findings presented in this report reflect the process of identifying areas needed for improvement, recommendations for instructional interventions, and evaluating the course after the interventions. Observations and faculty interviews revealed issues that arose from delivering this first online course. The email survey data, web-based survey, and their email communications with the instructor revealed the students' perception of the class and the problems they encountered. The findings are divided into three sections based on the process of formative approach.

Early to Mid-Semester – Before Intervention

Observation

After nearly three weeks, there had been very few postings to the course message boards. There were only 48 posts in the first three weeks of the class, an average of less than one post per student, per week. Several of these posts were related to technical issues such as where to post the answers to the individual questions and group questions.

Besides the limited postings, students were answering the case problems by copying out of the book. Once one person had posted an answer to the problem statement, the responses from each of the team members tended to be very similar and did not add new information to the discussion. There was not much interaction occurring among the group members except when they were ready to post their answers to the class discussion board. In addition, one of the postings indicated that there was not much communication occurring in other forms during the early part of the semester.

After observing the first three weeks of the class, the researchers requested an interview with the instructor to determine his perception of the class and to investigate whether other channels of communication were being used.

Faculty Interview

The initial interview was conducted four weeks into the semester and lasted two hours. After having taught classes in the field of business and insurance for over twenty years in a face-to-face format, the professor found that teaching via the Web presented a number of challenges. Underlying many of the specific issues that the professor was dealing with was a lack of time to develop and work on the class because it was being taught in addition to his normal class load.

New Pedagogy

When first considering how to re-structure the class to take advantage of the Web-based environment, the professor decided that he needed a new pedagogical approach. He researched a number of instructional strategies and decided that a problem-based learning approach would be most appropriate for the content of the course. Implementing this new approach, however, proved to be more difficult than anticipated.

The textbook traditionally used for the course was the primary resource for course material. The instructor adapted the textbook problems to the online environment and formed teams to work on solving a problem for each unit. Using this format, the professor hoped to stimulate conversation. By doing so, he believed that the students would become more engaged with the material and would have a stronger learning experience.

At the time of the first interview, there were few indications that the students were working beyond the material in the textbook to solve the problems. The professor expressed some frustration with the lack of depth to the responses and did not feel confident that this new approach was as effective as he had hoped. He did note, however, that there might have been some ambiguity in the stated objectives and expectations that the students had been given. While he had made clear that he would base a portion of the grade on class and group participation, he stated that he needed to communicate his expectations better to the class.

New Technology

The technology used for teaching the class was also a factor in how well interactions were occurring. While the professor was extremely competent using many computer programs such as spreadsheets, word processors and email, he was unfamiliar with the development tools for the Web. He stated that he had done some pilot testing with the courseware in the previous semester. During the semester break, however, the university had upgraded to a new version, changing the capabilities and functionality of the program. Even though the courseware had better capabilities for supporting teams, there were some unforeseen consequences.

Not having had the opportunity to test the new system, the professor did not anticipate the students' confusion with what message to post under which board: the Group Discussion Board (for team use) or the Class Discussion Board. He felt that these difficulties were hindering the classes' ability to communicate with each other and with him. Additionally, he found that he did not have the time to check all of the different areas where students might be communicating thus making it difficult to track where students might be having problems.

Student Interactions

The analysis of postings by students at an early part of the semester showed that there was very little use of the message boards, which were the intended mechanism for on-line discourse. When asking whether students were using any other mechanism (email, live chat, telephone) to communicate, the instructor stated that he did not have any indication that there were other methods being used.

The limited interaction was contrary to the instructor's goal that team members would work together to solve the problems. The instructor noted that students were reading the material because their answers on the discussion boards reflected their reading. They were not, however, interacting with each other in a way that contributed to the in-depth learning that the professor was trying to achieve.

Email Survey

The open-ended questions that were emailed to students near the middle of the semester gave insight into their perceptions of the course. While the questions were open ended, the responses were centered on a few key issues about the class. Given the professor's uncertainties about how well his methods and the technology were working, it was surprising to find that nearly all of the students who responded to the survey had a very favorable impression of the class.

One of the major findings in this survey was that students liked the freedom and convenience of taking a class over the Web. For some students, it was the only way they could take such a class because they had work and family commitments. Many thought the technology was being used appropriately to meet their needs and appreciated the use of message boards over email or other communication options. Additionally, the courseware was viewed as easy to use and was liked by most of the students.

While most of the respondents were satisfied with the overall structure and learning occurring in the course, there were a number of suggested improvements. Many of the changes revolved around the organization and expectations for class communication. Students wanted to have concrete guidelines for project work. Several mentioned that they were unsure about what was expected from their group in terms of final deliverables. There was also uncertainty about what criteria were being used to determine their individual participation in the class or within their teams. The most often mentioned concern from the students was that the professor did not seem to be giving enough feedback in the course Website. Students wanted more ongoing commentary from the instructor so that they would know whether they were meeting expectations.

Mid-semester Intervention

Based on the major trends identified, the researchers proposed several strategies to the instructor to improve the course. While the strategies were developed as a result of the problems, they were also designed to work within the limited time budget the professor had to make changes to the course.

The first strategy researchers recommended was to use technology to improve interaction. Improving student interaction in the course is a very complex issue and is very important in a problem-based learning class with a team-based approach. Distance students needed a clear set of guidelines for how to communicate online. The recommended guidelines included two parts. One was to tell students what technology to use and when. The second component in the guidelines was to specify how the technology was to be used. The students who were less experienced in online communication did not appear to understand what they should post in the different message areas or how to use the tools effectively.

The second strategy we recommended was to provide more feedback. Given the time pressure faced by the instructor, this was a more challenging problem. Addressing the issues related to student communication might help this by encouraging the behavior the professor had hoped to occur (more student-student interaction). If, for example, students knew that there were specified areas within the course site where they could get feedback, then the professor could centralize his responses and answers to one student's questions which might help others in the class. Such an approach would prevent the instructor from having to go into each discussion area for each group and for the class to address specific issues.

Third, we recommended providing specific guidelines for the projects. While the syllabus had clearly stated objectives for the outcomes in the class, there was little explicit information about how evaluation would occur. In a face-to-face situation, issues like class participation can be defined on an ongoing basis, depending on the lesson for that day. Online, however, rules for participation have to be more clearly defined. More precise project guidelines would help clarify students' uncertainty about what was expected from them in terms of group work.

Post Intervention Data

<u>Student Survey</u>

The student survey was designed, in part, based on issues found in the interview with the professor from students' comments sent in via email. Twelve out of the fifteen students (80%) in the class completed the survey. The survey results helped confirm trends found in the qualitative data. The survey was designed to assess students' learning experience with this online course, their opinions about the online test, and other issues that concerned them. Demographic data showed that the majority (83%) of the students had never taken an online course before this class. Interestingly, none of the students reported the courseware to be difficult to use (learner-technology interaction). The results students' opinions on group work, students' learning, online tests, and instructor's feedback will be summarized below (interactions between learners, instructor, content).

Table 1: Summary of Survey Findings (The number in () indicates the number of respondents)

<table>
<tr><th colspan="2">Questions</th><th>Strongly Disagree</th><th>Disagree</th><th>No Opinion</th><th>Agree</th><th>Strong Agree</th></tr>
<tr><td colspan="2">Our group was able to work effectively as a team.</td><td>8% (1)</td><td>25% (3)</td><td>8% (1)</td><td>42% (5)</td><td>17% (2)</td></tr>
<tr><td colspan="2">I learned more by doing this project collaboratively with other team members than I would have on my own.</td><td>17% (2)</td><td>50% (6)</td><td>8% (1)</td><td>17% (2)</td><td>8% (1)</td></tr>
<tr><td colspan="2">This class met the expectations I had for learning the material.</td><td>8% (1)</td><td>42% (5)</td><td>17% (2)</td><td>17% (2)</td><td>8% (1)</td></tr>
<tr><td colspan="2">I found online discussions to be beneficial to my learning experience.</td><td>8% (1)</td><td>33% (4)</td><td>17% (2)</td><td>42% (5)</td><td>0% (0)</td></tr>
<tr><td rowspan="2">Online Test</td><td>The content of online test was a fair assessment of what I was expected to learn.</td><td>8% (1)</td><td>8% (1)</td><td>42% (5)</td><td>42% (5)</td><td>0% (0)</td></tr>
<tr><td>The format of the test was appropriate for an online class.</td><td>8% (1)</td><td>25% (3)</td><td>33% (4)</td><td>33% (4)</td><td>0% (0)</td></tr>
<tr><td colspan="2">The instructor provided sufficient feedback.</td><td>0% (0)</td><td>33% (4)</td><td>25% (3)</td><td>42% (5)</td><td>0% (0)</td></tr>
</table>

The results on group work showed that 59% (7 out of 12) felt they were able to work effectively with their teams. When asked if working collaboratively with other team members helped them learn more than they would have working on their own, 67% (8 out of 12) disagreed or strongly disagreed, one responded with no opinion and 3 agreed. Related to this finding was that 6 students (out of 11 who responded this question) did not think that their expectations for learning the material had been met through the class. Three of them agreed the class met their expectation, and 2 responded with no opinion. Regarding the online discussions, 5 students (41%) agreed that they were beneficial to their learning experience; 2 students (17%) reported no opinion, and 5 students (42%) did not think online discussions were beneficial to their learning.

The class was somewhat divided over issues related to an online test. About 16% (2 students) of the class did not think the test content was a fair assessment of what they were supposed to learn, 42% had no opinion (5 students), and 42% (5 students) thought the test was fair. As for appropriateness of test format for this online course (timed multiple choice questions and essay tests), 33% (4 students) responded disagree, no opinion, and agree respectively.

Students' opinions on instructor's feedback were also divided. Five students indicted that the instructor provided sufficient feedback, 3 students responded no opinion, and 4 students did not think the feedback was sufficient.

Students' responses to the opened-ended questions revealed more detailed information about their perception of the course. These and the analysis results from students and instructors' email messages will be summarized below. These qualitative data gathered from students' survey informed the quantitative results of students' perception of the class.

Students' Perspective on the Class

Several students mentioned that they enjoyed the flexibility and convenience of taking an online course. They also liked the professor's patience and understanding in dealing with problems they ran into. Some students enjoyed the group work and online discussions. Three prominent themes regarding to problems and concerns emerged from the qualitative data analysis.

Technical concerns

Although the courseware was relatively user-friendly, students constantly ran into technical problems throughout the semester. Several students had difficulties in taking the online exam. The restriction of the exam format and lack of flexibility in test sequence caused some students not to perform as well as they expected. Some students got a zero on particular sections due to technical restrictions. The instructor had to reset the test for these students. Other technical problems included lost connections during the test, transferring files, and posting and locating messages at the right place.

Students reported in the survey that they did not think Blackboard was difficult to use. The email messages sent back and forth between students and instructor revealed that there were more technical problems than questions about assignments or reading. The instructor had to spend a great deal of time resolving these technical problems.

Assessment

Students were very concerned about their grade, and how they were evaluated on the individual participation and group participation. Several students emailed the instructor asking what grade they might get and how they could improve their grade. In addition, students were concerned and some were frustrated by the format and technical difficulty of the online test. More than a couple of students mentioned that they were not good test takers even if they knew the material well. The timed exam made it more difficult.

Group work

This class used small groups to work on mini-projects. It is not surprising that there were some complaints about uneven participation. "Free ride" (no contribution to the group task but get the credit) was rather bothersome for the students who contributed more for the group project. Some students were concerned about this fairness issue in the assessment.

A couple of other issues, not reflected by majority of the students, are worth mentioning. Two students thought that the online class lacked social interaction. They felt they would learn more through hands-on and face-to-face classes. In addition, insurance is a hard subject (a comment made by one student), and that not being able to discuss it in class made it hard to understand.

Instructor's Perspective on the Class

Through our informal conversations and semi-structured interview, the instructor expressed that formative evaluation was a very good reinforcement. He stated that it was good to have an independent source to provide feedback. Students seemed to like this idea and were quite open in talking about their issues and concerns. He thought a mid-term formative evaluation and recommendations were useful. If he had time to implement them, he projected these recommendations would have helped improve this class. Based on previous experience, the instructor had mixed feelings about his first online course.

The instructor did not think that students accomplished what he wanted. He expected them to go beyond the textbook, but only one or two students did that (consistent with his comment earlier in the semester). He also felt that students did not learn as much as they would have in an on-campus class. With his on-campus face-to-face class, he was able to present extra material. With this Internet class, although databases were provided, very few students used them. But one of the things that instructor really enjoyed was the rapport he and some of his students established through emailing back and forth to address questions and concerns. He found this online rapport was quite rewarding.

Discussion

The researchers began the study by observing the visible interaction occurring on the course Web site. Analyzing the evaluation data identified three general major difficulties. First, very limited interaction occurred on the course message boards during early part of the semester. One of the reasons for this apparent lack of student involvement was that most of the students had never taken an online class before, and they had no experience in how that should communicate within the courseware. Additionally, although the instructor was aware of the lack of student involvement in the course, his limited time and heavy workload kept him from putting more effort into facilitating the students' online communications.

The second major problem was the amount of feedback students were getting from the instructor. The same factor, time shortage, also affected the amount of individual feedback the instructor was able to give to the students. The professor hoped that students would interact more with each other and would learn from these interactions, rather than relying on him for the majority of the feedback.

The third major issue that emerged was related to standards for the class. Students indicated that they were not sure how they were being evaluated. This uncertainty was especially true for the participation portion of their grade. Clear and specific guidelines about how participation was being evaluated (for example, by number of message board postings, depth of the posts, etc.) would help clarify the students' uncertainties. Likewise, providing explicit guidelines for group projects would have helped address students' concerns about group work, which could lead to more participation from team members.

There was a high degree of congruence between the instructor's beliefs and student attitudes on these three major issues. The instructor, however, had a much more negative view of how the class was progressing than the students did. He felt that the students were going to be very disappointed with the overall experience they were getting from the class. In contrast, email to the research team and other survey data revealed that while students had specific issues they wanted to see improved, they were generally positive about the class.

This course presented a couple of challenges for the instructor. The first challenge was time management. Due to his busy schedule and heavy workload, he was not able to facilitate the class discussions and group activities as effectively as he wanted to. Much time was spent on answering students' technical questions. If he had been free from dealing with these technical responsibilities, he would have been able to put more effort into the development of the course. Another challenge the instructor faced was finding the best fit of instructional strategy to this particular introductory course. There is very little literature about using PBL in Web-based instruction. Knowing how to implement PBL in an Internet class and how to facilitate group problem solving presented a great challenge for the instructor. With limited guidance from the literature, one had to explore the strategies through trial and error.

Conclusion

The instructor in this study was very motivated to try innovative teaching techniques and strategies. He spent time reading pedagogical literature and pilot testing the technology before teaching the class. Additionally, the class was being taught voluntarily, despite his already busy schedule.

Even with a highly motivated faculty member, however, implementing an online class is a difficult task that requires new skills and strategies for success. More importantly, the instructor needs support from the university and his or her department to effectively work with students at a distance. The support needed most is time to plan, build the online courses, and ongoing technical support.

As universities continue the mad dash to offer their courses online, reasonable timelines for design and development should be taken into account. If faculty have to use untested methods on constantly shifting courseware with their students, sound instructional practice would suggest that this is not good for the students, faculty, or, in the long run, the university. The reality is, however, that there will continue to be uncertainty about the best practices for online course delivery for the near future. Formatively evaluating their courses and making improvements throughout the semester can reduce some of the problems faced by faculty.

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Performance Data in Professional Publications: Signs of Traffic on the Road Less-Traveled

JennyLynn Werner
SixSigma Performance

James D. Klein
Arizona State University

Abstract

The purpose of this review is to classify articles in four Human Performance Technology publications for 1997 through 1999. Two publications are selected from each of the two largest professional organizations for performance practitioners; the publishers are the American Society for Training and Development, and the International Society for Performance Improvement. Articles were classified according to criteria derived from Klein (1997), and Dick & Dick (1989).

Introduction

Recently, a number of calls for measurement of training effectiveness have indicated that training and performance interventions should be expected to add value in a way that can be measured (Anglin, et al, 2000). Certainly the calls for data are appropriate; for performance professionals to earn any credibility, they must lead the way in demonstrating observable, measurable outcomes because those outcomes are demanded of our customers for their jobs.

Calls for data come from experienced practitioners, distinguished academics, and customers and there is now a greater focus and emphasis on development of the profession as well as related aspects such as ethics, qualifications, competencies, and standards (Merrill, et. al, 1996; Gery, 1999; Shrock, 1999; Kimball, 1999; Brethower, 2000; IBSTPI, 1998).

The increased demands on a performance professional's skill set and knowledge base require high quality and effective professional development opportunities. Often, professional organizations are utilized for most if not all of an individual's professional development efforts as many practitioners read the organization's publications as they strive to improve their skills and many attend an annual conference as well.

The increasing importance of these publications was the impetus for this review. A systematic assessment of the publications read by numerous practitioners is helpful for a number of reasons. As in any performance question, the current status must be documented in order to determine if the goal is being met. This review is not without precedence; a number of reviews have been conducted that examine the content and scope of Instructional Technology publications (Klein, 1997; Dick & Dick, 1989; Driscoll, 1997; Driscoll & Dick, 1999).

Publication and Article Selection

The purpose of this review was to classify the articles in four of the most popular publications in the Human Performance Technology field, for the period from January 1997 through December 1999. Those four publications are: Training and Development, and Technical Training - both published by ASTD (American Society for Training and Development), as well as Performance Improvement Quarterly, and Performance Improvement - both published by ISPI (International Society for Performance Improvement). ISPI and ASTD are currently the two dominant professional organizations for practitioners working in the performance field.

Organizational Missions (quoted directly from organizational websites)

ISPI – http://www.ispi.org

"Founded in 1962, the International Society for Performance Improvement (ISPI) is the leading international association dedicated to improving productivity and performance in the workplace. ISPI represents

more than 10,000 international and chapter members throughout the United States, Canada, and 40 other countries. ISPI's mission is to develop and recognize the proficiency of our members and advocate the use of Human Performance Technology. Assembling an Annual Conference & Expo and other educational events like the Institutes, publishing books and periodicals, and supporting research, and recognizing outstanding achievements through the Awards of Excellence program are some of the ways ISPI works toward achieving this mission."

ASTD – http://www.astd.org

"Founded in 1944, ASTD is the world's premier professional association and leading resource on workplace learning and performance issues. ASTD provides information, research, analysis and practical information derived from its own research, the knowledge and experience of its members, its conferences, expositions, seminars, publications and the coalitions and partnerships it has built through research and policy work. ASTD's membership includes more than 70,000 people, working in the field of workplace performance in 100 countries worldwide. Its leadership and members work in more than 15,000 multinational corporations, small and medium sized businesses, government agencies, colleges and universities. ASTD's publications cover all aspects of learning and performance in the workplace. Its books, magazines, periodicals and reports address the leading performance issues facing business and the profession and provide practical workplace tools for managers, professionals and technical workers."

Publication Descriptions

Performance Improvement (PI)

"*PI* is the preeminent journal focusing on today's issues of individual and organizational improvement. Published 10 times a year, *PI* is filled with information that can improve your skills and effectiveness. Since 1963, *PI* has consistently addressed improving human performance through a wide range of instructional and non-instructional interventions, as well as imparting the tools of performance technology and the challenges and new frontiers facing performance technologists. Published monthly except for combined May/June and November/December issues, this acclaimed journal is geared toward practitioners of performance technology in the workplace. Learn from hands-on experiences with models, interventions, 'how-to' guides, and ready-to-use job aids, as well as research articles. Performance Improvement also offers updates on trends, reviews, and field viewpoints. The journal deals with all types of interventions and all phases of the HPT process. The common theme is performance improvement practice or technique that is supported by research or germane theory."

Performance Improvement Quarterly (PIQ)

"*PIQ* is the scholarly publication of studies reflecting research in the field of human performance technology. It provides an avenue for communication and stimulates discussion among professionals in the field who desire a sophisticated examination of issues in human performance, instructional design and development, and human learning. Now in its 11th year, this highly-regarded publication continues to be a leader in defining the field of human performance technology."

Training and Development (T&D)

"*T&D* is the flagship publication of the industry," according to the ASTD website. "*Training & Development* is an official publication of ASTD, a not-for-profit association of professionals in the field of human resource development, workplace learning, and performance improvement. *T&D* is a monthly magazine available to ASTD national members as part of their dues, and also by subscription and single-copy sales. Our readers are degreed training and development professionals and line managers. They range from new practitioners to seasoned executives in business, government, academia, and consulting. Our goals are to:

- provide useful, how-to information on current best practices
- share new theories and their applications
- report emerging trends
- address relevant and pivotal issues to the field."

Technical Training Magazine (TTM)

"Technical Training magazine, published by ASTD from 1990 to 1999, is the print-based predecessor to Learning Circuits. It covered news, trends, training techniques and technologies in the technical training arena."

Methodology

The sample under investigation consisted of two publications from each of the two major professional development organizations for individuals working in training, ISPI (Performance Improvement Quarterly and Performance Improvement) and ASTD (Training & Development Magazine and Technical Training Magazine). Each publication was reviewed for three calendar years -- 1997, 1998, and 1999. Only the informational articles were reviewed from each issue; book reviews, brief notes, editorials and commentaries, and indexes and bibliographies were not included in the review. The publications contained 800 articles of all types, 700 of which met the criteria of informational articles for the review. The issues reviewed for each publication were:

- Performance Improvement Quarterly, Volume 10 (1997) Issues 1-4; Volume 11 (1998) Issues 1-4; Volume 12 (1999) Issues 1-4;
- Performance Improvement, Volume 36 (1997) Issues 1-10; Volume 37 (1998) Issues 1-9; Volume 38 (1999) Issues 1-10;
- Training and Development, Volume 34 (1997) Issues 1-12; Volume 35 (1998) Issues 1-12; Volume 36 (1999) Issues 1-12;
- Technical Training Magazine, Volume 8 (1997) Issues 1-8; Volume 9 (1998) Issues 1-8; Volume 10 (1999) Issues 1-6.

Published articles were classified according to specific criteria which were derived from Klein (1997) and Dick & Dick (1989). Categories used in previous reviews include: case studies, evaluation reports, descriptive reports, literature reviews, empirical research, procedural how-to, and others. Klein used four categories to review the articles published in ETR&D, the article which provided the framework and basic methodology for this review. Those four categories were collapsed, due to the small numbers found of empirical research and case studies, to three categories rather than four: empirical research (including case studies, which are in fact a type of empirical research), descriptions or descriptive reports (do not contain data and are not based in the literature), and literature reviews.

Inter-rater reliability was measured by comparing independent assessments of a subset of the articles reviewed for the study. Twenty-five articles, including at least one from each category, were reviewed separately by the authors, and the assessments compared. It was not possible to review at least one of each type for each publication as two of the publications were not well-distributed in terms of article types. The authors agreed on 23 of 25, and the inter-rater reliability value was .92.

Results

Table 1 shows how many empirical studies, literature reviews, descriptive articles, and editorials were published in the four journals from 1997-1999. These data show that most of the articles published in the four journals were descriptive reports that did not contain data. Articles that included data based on empirical research accounted for only 7% of all articles included in this study. Most of these empirical studies were published in *PIQ*.

Table 1. Numbers by types by publication:

	Empirical Research	Literature Review	Description / Discussion	Editorial / Commentary	Totals
PIQ	37	33	31	24	125
PI	14	11	173	80	278
T&D	05	01	275	01	282
TTM	00	00	101	03	104
Totals	56	45	580	108	789

Implications and considerations

The intent of this study is to provide information on the content of the professional publications useful for a broad audience, ranging from graduate students preparing for successful careers in Instructional/Performance Technology, professors working to prepare tomorrow's performance professionals, as well as current practitioners and their managers, with information to help them select the professional publications that best fulfill their development needs. Assessing the current status as well as annual trends provides data to those who must determine how to spend their, often scarce, resources for employee or student professional development.

There is no intent to compare these publications to each other, or to compare the organizations themselves. It is important to note that this is not a call for these organizations to publish the type of scholarly articles found in journals like ETR&D. However, a basic level of quality is still required in order for these journals to actually provide good material for professional development, and data (focus on results) is essential for this.

The data as collected and reported provide critical information for professionals in the ID/PT/IT field: The astonishing lack of data impact the credibility and respect of all practitioners in the field. If performance accountability does not start with performance experts, how can it start with anyone else? There are implications for faculty in Instructional Technology programs, because those faculty members develop and teach curricula that must includes robust courses and experience in evaluation, in order for practitioners to be better trained to complete evaluations and report data routinely.

Conclusion

Data, accountability, and credibility in ID/IT – practitioners can gain credibility and earn respect by collecting, responding to, and publishing the data from projects. Those who demonstrate this level of discipline and are willing to be accountable at the same levels of other professionals can begin the turn around.

As consumers of training become better educated about what training / instruction is and what they should expect from it, standards will rise for practitioners. Those who lack skills and knowledge necessary to routinely develop and evaluate performance-based training may find themselves in drastic career straits once the customers (the learners / trainees) and performance-owning managers begin to expect training and performance interventions to work well. Data is part of the fundamental ID process for adding value; it provides a foundation for continuous improvement. The critical nature of expertise and the power of process is captured by the following paragraph:

> Perhaps the greatest strength of the ISD process is the evolutionary nature of the prescriptive, research-based model itself. While the practice of ISD still retains the strengths of the empirical evaluation and revision cycles, to the extent research and experience permit, it is prescriptive. That is, rather than depending extensively on the test-revision cycle to generate effective instruction in an iterative manner, every attempt is made to incorporate research findings and past experience into the detailed procedures and supporting ISD documentation to ensure that the instruction developed comes as close to the mark as possible the first time. This improves the validity of the process while also improving reliability. This has proven to be a powerful tool in large scale ISD. In addition, as the process provides more data from the constant evaluation process, the procedures can be continually improved.
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Effect of Time and Level of Visual Enhancement in Facilitating Student Achievement of Different Educational Objectives

Frank Wilson
Strategic Management Group, Inc.

Francis Dwyer
Pennsylvania State University

Abstract

The purpose of this study was to determine: a. how different types of dynamic visual facilitate the achievement of specific types of educational objectives, b. whether the use of dynamic visualization influenced the amount of time needed by learners to process the information, and c. whether there is an interaction between the amount of time learners view the animation and the different levels of dynamic visualization. Two hundred students were randomly assigned to four treatments, received their respective instructional presentation and received four individual criterion measures. Results indicated that insignificant differences in achievement existed among the visual treatment groups on all criterion measures and that an insignificant interaction was found to exist between time and dynamic visualization.

Introduction

Visualization properly designed, and positioned in instructional presentations has been found to be an important variable in facilitating student achievement of different types of educational objectives (Dwyer, 1978). However, the use of visualization alone, while it can significantly improve achievement, does not always optimize achievement of the more complex types of learning outcomes (Dwyer, 1987). Static visuals in and of themselves are limited in their ability to instigate the higher levels of information processing since at best they represent suggested motion attributes in dramatic form (Reiber & Kini, 1996). Park and Hopkins (1993) have suggested that dynamic visual displays which utilize graphic movement in visualization to identify, interpret and reduce the level of abstraction will facilitate higher levels of information processing and lead to higher levels of achievement. It is assumed that the static visuals and narration along with increased animation would provide additive codes leading to more effective encoding and knowledge transfer of the information being presented. It was also anticipated that the use of animation (changing color, motion, etc.) in static visuals would focus learning attention more precisely, facilitate focused interaction and thereby result in improved learning outcomes. Additionally, an increased interaction with the content materials would necessitate an increased amount of time required for learners to interact and process the information being presented. Carroll (1963) reports that the amount of time required would be proportional to the complexity of the visualization, the types of animation and the level of learning to be achieved. Specifically, the purpose of this study was to: a. determine how different types of dynamic visuals facilitate the achievement of specific types of educational objectives, b. determine whether the use of dynamic visualization influences the amount of time needed by learners to process the information and c. determine whether there is an interaction between amount of time learners view the animation and the different levels of dynamic visualization.

Methodology

The 2000 word instructional unit used in study was intended to instruct learners on the nomenclature of the heart, and the functions of the various parts of the heart during its systolic and diastolic phases. The lesson included 19 separate "instructional frames" comprised of sound and graphics elements. Each "frame" was accompanied by some audio narration that described and supported the visual being shown. In this case, it identified and described the parts of the heart and their functions. The lesson allowed the learner only one pathway (a linear progression) through the lesson, so that the 19 instructional frames comprising the lesson were presented to all students in a fixed sequence. Within each instructional frame there was a fixed sequence of audio and visual components. Macromedia Director was chosen for development and delivery since there was a need for the simultaneous presentations of audio narration and dynamic visual elements. For each of the 19 frames, the appearance of the graphic was followed by five seconds of silence, then by the appropriate narration. Following the narration the

student was given an opportunity for silent reflection. Depending on the timing treatment, this post-narration time was either 8 seconds (T_1) or self-paced, (T_2). A stop-watch script was written into the instructional program, which recorded each student's reflection time. The watch began automatically at the end of the narration for each frame. Simultaneously, a button appeared in the frame entitled "Continue," which the student could mouse-click at any time to move on to the next frame of instruction.

Prior to the instructional unit, the participants were given a brief orientation to the study, which explained its purpose, and informed them about the use of the silent time during each frame. It was explained that: 1) the silent time preceding the narration was designed to familiarize them with, and orient them to the new features presented in the new visual, 2) the audio narration, to communicate the instructional message, or content for the frame, and 3) the silent time following the narration, to allow a time for reflection and rehearsal. The participants also were asked to follow this strategy carefully and consistently throughout the learning module. The orientation also informed the student about the testing procedure as well as the approximate time it would take to complete the experiment. They were asked to place their complete focus on the learning at hand and to participate as fully as possible in all aspects of the learning and testing experience.

Instructional Time ("T" Variable)

The instructional time variable examined how enhancements such as dynamic visualization in instruction, affected the length of time students' needed to "attend to" (study) the additional visual cues, or details. Each of the dynamic visual strategies added visual information that the learner was required to process. For the purposes of this study, pre-narration time and narration time remained constant across the treatments. Pre-narration time – when a new visual appeared, five seconds of silence was given for students to orient themselves to the components of the new visual before the narration began. Since all subjects were given this period of orientation prior to the narration, it was considered a constant. Narration time – although the timing for the narration varied from scene to scene, depending on the complexity of each explanation, it was identical from treatment to treatment. In other words, each student receiving instruction spent an equal time listening to the narrative. Therefore, narration time was considered a constant. Post-narration time – for the purposes of this study, only the period of time that followed the narration was manipulated. The students were directed to use this time to scan the visual and to reflect upon the information presented by the narration. Students were randomly assigned to one of two timing treatments.

1. T_1 – Timing Treatment #1 – 8 seconds:

Post-narration time equaled 8 seconds for all frames. Once the 8 seconds elapsed, the instructional program automatically advanced to the next frame of instruction.

2. T_2 – Timing Treatment #2 – self paced:

Post-narration time was controlled by the learner. When the narration for the frame was finished a "continue" button appeared on the screen. At this point, the student could study the current visual for as long as needed, and click on the button to proceed to the next frame. For this self-paced treatment, study times were recorded for each learner for each frame.

Treatments - Visual Enhancements ("V" Variable)

1. V_1 – Still Graphics (Control): The Control Group treatment contained 19 static visuals frames consisting of colored line drawings of the human heart. These simple illustrations contained character-generated words on the screen in combination with arrows and labels that identified the elements being presented in the narration.

2. V_2 – Progressive Reveal: Progressive Reveal was a dynamic visual enhancement that entailed a sudden color change in, or a sudden addition of graphic elements. Location of the animation enhancements in each treatment was based on item analysis conducted by Torres (1990). A sudden color change was intended to draw the learner's attention (cueing) to that part of the graphic being discussed in the narration. In the heart presentation, whenever an element of the graphic is mentioned, or described, the viewer's eye is drawn to that element by a sudden change in color in the element. The sudden additional of an arrow during narration represented either the direction of some movement (blood flow), or of some hidden pressure that occurred in the heart. The Progressive Reveal is intended to help the learner locate the important elements within the whole, and to ignore the extraneous detail. Progressive Reveal was intended to improve student's abilities on identification, terminology and comprehension test items that require students to recall names of parts or functions.

3. V_3 – Animation: Animation was a dynamic visual enhancement that generated graphic motion simulating the mechanics of the real world, such as the flow of blood, or motions of the valves, muscles, and other moving elements of the heart. This dynamic visual display added the element of motion, which was intended to graphically demonstrate the movement of parts or the flow of blood through the heart, as it was being described in the audio narrative. Animation was intended to promote learning at the conceptual and rule level. The animation treatment would most benefit students on terminology and comprehension questions that recalled information related to motions, operations, processes, functions and how they were interrelated.
4. V_4 – Animation and Progressive Reveal: This treatment combined the elements of Progressive Reveal and Animation described above. This combination of dynamic visual elements attempted to focus students' attention on relevant details and on the movements, operations, processes, and functions inherent in the elements being described by the audio narrative. When used, this combination of methods was intended to give the student a more comprehensive understanding of the interrelationships between the parts and functions of the heart.

Each enhancement described above was assigned to a frame on the basis of its value for supporting certain instructional objectives articulated in the narration for that frame. In other words, the Progressive Reveal treatment only was used when the narration identified, described, or named parts or functions of the heart, while the Animation treatment only was used when the narration described some movement, flow, or process.

Table 1. Summary of Visual Enhancement Strategies

Treatment V_1 (control)	Narration, Color Heart Drawings, Labels
Treatment V_2	Treatment, Color Heart Drawings, Labels, and Progressive Reveal
Treatment V_3	Narration, Color Heart Drawing, Labels, and Animation
Treatment V_4	Narration, Color Heart Drawings, Labels, Animation and Progressive Reveal

During the presentation of one of the three visually enhanced treatments, the selection and use of that particular visual enhancement strategy was synchronized with the audio narration during any instructional frame, or any portion of a frame, according to the following criteria:

Throughout Control Treatment V_1, still graphic images were employed throughout the presentation. A total of 19 images were employed. For Frame #18, which described the Systolic Phase (in which the heart exhibits two distinct movements), two still images were presented consecutively. In treatments V_2 and V_4, the still graphics were enhanced by the addition of Progressive Reveal. Whenever parts of the heart were being introduced, described, or identified, the parts and their labels would suddenly change color to attract the learner's attention to those elements. In Treatment V_2 and V_4, arrows appeared as needed to show the direction of some movement or force. During Treatments V_3 and V_4, animation was used only during those frames, or potions of frames that describe motion, including the contraction of the heart, the movement of internal parts of the heart, or the flow of blood from chamber to chamber. During Treatment V_4, both still and animated frames were enhanced by the addition of Progressive Reveal as needed when the narrative introduced, described or identified parts or areas of the heart. As in Treatment V_2, this enhancement involved a sudden color change for the part and for its corresponding label.

Criterion Measures

The dependent variables used in this study were the achievement levels of students on specific learning objectives. Achievement of the specific learning objectives was determined by the following criterion measures (Dwyer, 1978, 45-47)

Drawing Test (20 items): This test consisted of a numbered list of twenty items (naming the parts of the heart) depicted in the instructional unit. The students were asked to draw a reasonable facsimile of the human heart, and to place the number corresponding to each item in its correct location on the drawing. Emphasis was placed on the accurate positioning of the numbered items, not on the quality of the drawing. The drawing test was intended to

assess the students' ability to reproduce or reconstruct the heart and to maintain the appropriate special and contextual relationship between and among the various parts.

Terminology Test (20 items): Given five choices in each item in a multiple choice test, learners were required to select the part or function of the heart described in each item. This test was designed to measure a student's ability to choose the appropriate graphic representation of a part or function, given an abstract definition or description. This related to knowledge of facts, terms, and definitions, which would be needed as prerequisites for the learning of concepts, rules, and principles, the higher intellectual skills, which would entail more complex levels of learning abstraction.

Comprehension test (20 items): Each question described the activity in a certain part of the heart, at a single moment in the cycle of the heart's movements. It required students to show how another part (or parts) would appear at that same moment by selecting an illustration which most accurately represented that condition. This test required students to have a thorough understanding of the heart, its parts, its sequence of movements and cycles, its simultaneous processes, and the relationships between and among the parts of the heart at critical moments during its cycle of activity. This test was intended to measure a students' ability to apply the facts, concepts, rules, and processes presented in the instruction.

In the case of the Drawing Test, Dwyer's original version (1965) was used. The visual version of the multiple choice tests for identification, terminology, and comprehension were taken from Dwyer (1985). In each case, the item stems were textual, while the options were visual (line drawings).

Total Comprehension Measure (80 items): This score was obtained by adding the scores for all four tests into a total test score. It was intended to provide a comprehensive assessment of the learner's overall understanding of the content presented.

Experimental Design

The study utilized a randomized, post test only, control group design. Each of the four visual treatments was tested against the two timing patterns in a 4 (visualization) x 2 (timing) mixed factorial design (Campbell & Stanley, 1966). Each of the eight treatments were subjected to five separate post-tests, or dependent measures. In Table 3, the post-tests are represented by 0_1, 0_2, 0_3, 0_4, 0_5, which refer to Drawing, Identification, Terminology, Comprehension, and Total Comprehension tests, respectively.

Table 2. Mixed Factorial Design

Timing (T)	8-Second (T1)	Self-Paced (T2)
Visualization (V)	V_1T_1	V_1T_2
Still Images – Control (V_1)	V_2T_1	V_2T_2
Animation (V_2)	V_3T_1	V_3T_2
Graphic Reveal (V_3)	V_3T_1	V_3T_2
Animation and Graphic Reveal (V_4)	V_4T_1	V_4T_2

Table 3. Combinations of Treatments and Post-Tests

Tests (O) Treatments (V&T)	Drawing (O_1)	Ident. (O_2)	Termin. (O_3)	Comp. (O_4)	Total Comp (O_5)
V_1T_1	$V_1T_1O_1$	$V_1T_1O_2$	$V_1T_1O_3$	$V_1T_1O_4$	$V_1T_1O_5$
V_2T_1	$V_2T_1O_1$	$V_2T_1O_2$	$V_2T_1O_3$	$V_2T_1O_4$	$V_2T_1O_5$
V_3T_1	$V_3T_1O_1$	$V_3T_1O_2$	$V_3T_1O_3$	$V_3T_1O_4$	$V_3T_1O_5$
V_4T_1	$V_4T_1O_1$	$V_4T_1O_2$	$V_4T_1O_3$	$V_4T_1O_4$	$V_4T_1O_5$
V_1T_2	$V_1T_2O_1$	$V_1T_2O_2$	$V_1T_2O_3$	$V_1T_2O_4$	$V_1T_2O_5$
V_2T_2	$V_2T_2O_1$	$V_2T_2O_2$	$V_2T_2O_3$	$V_2T_2O_4$	$V_2T_2O_5$
V_3T_2	$V_3T_2O_1$	$V_3T_2O_2$	$V_3T_2O_3$	$V_3T_2O_4$	$V_3T_2O_5$
V_4T_2	$V_4T_2O_1$	$V_4T_2O_2$	$V_4T_2O_3$	$V_4T_2O_4$	$V_4T_2O_5$

Result and Discussion

Table 4. Mean Scores Achieved by Students on Each of the Criterion Tests

			Draw.	Ident.	Term.	Comp.	Total Comp.
Group	Treatment	N	Mean	Mean	Mean	Mean	Mean
V1	Static	50	17.50	17.72	14.06	13.16	62.44
V2	Progressive Reveal	50	15.78	17.40	13.20	12.76	59.14
V3	Animated	50	16.78	17.80	13.42	12.62	60.62
V3	Combined	50	16.12	16.96	12.90	12.26	58.24

ANOVAs conducted on the individual and total criterion measures indicated insignificant differences in achievement among the visual treatments. Significant differences in favor of the self-paced treatments were found to exist on the Drawing ($F=6.81$, $d_f=1/2$, $p.<.05$) and total Criterion Measures ($F=4.59$, $d_f=1/2$, $p.<.05$).

Table 5 presents the study times interacted with their respective treatments. Insignificant interactions were found to exist between the visual treatments and time on all criterion measure.

Table 5. Study Times (Means)

Group	Treatment	T_1 8-Second	T_2 Self-Paced
V_1	Static	152 sec.	173 sec.
V_2	Progressive Reveal	152 sec.	190 sec.
V_3	Animated	152 sec.	249 sec.
V_4	Combined	152 sec.	170 sec.

The results of this study indicated that the types of animation strategies employed provided insignificant differences in student achievement on the types of criterion measures measuring achievement of different types of educational objectives. The study also found that timed sequences were most efficient in terms of amount of time students spent interacting with the visualized treatments. These results implied that, at least for this group of learners, static visualization was sufficient to facilitate learning. This contradicted the current ideas and trends concerning the selection and use of animation in educational and learning environments.

A number of possible explanations may be suggested: (a) students were not properly oriented to the importance of the animation and thereby were not prepared to profit from the information being provided, (b) the experimental environment, itself, motivated all students, so that the control students interacting with the static visuals achieved as well as the students receiving the animated visualization, (c) the animation employed may not have been sufficiently intense so as to instigate the levels of information processing necessary to move the information from short term into long term memory. Finally, (d) the high cognitive abilities of the students involved may have pre-empted the need for dynamic visual support. Consequently, the students may not have worked conscientiously to integrate the animated information into higher levels of cognitive attainment (Rieber & Keni, 1991). In actuality their attention to the dynamic visualization may have impeded rather than facilitated the required levels of information processing.

It is also important to report that studies conducted by Lumsdaine, Sultzer, and Kopstein (1961) and May & Lumsdaine (1958) have indicated that animation, which is being used primarily to enhance the attention focusing or realism of a presentation, does not have a significant effect on learning. Anglin, Towers,and Levie (1996) have indicated that some progress is being made on visualization in facilitating knowledge acquisition, knowledge integration, and knowledge generation.

Considering the relationship between cost of producing different types of graphics and their relative effectiveness in promoting learning, this study demonstrated that, in some cases, still images can be as effective as more-costly animations. Hopefully, this will stimulate additional work into this important area of research.

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The Effects Of Trained Moderation In Online Asynchronous Distance Learning

David Winograd
State University of New York College at Potsdam

Abstract

Online computer conferences used to assist distance learning courses often fail because the moderator—usually the instructor responsible for the conference—is not properly trained in techniques that build a community of learners. It has often been assumed that the skills required to create a vibrant classroom discussion translated easily to an online forum. This has been rarely the case.

This study utilized the qualitative methods of grounded theory and narrative research to explore how a moderator, after undergoing training, would affect students in one of three segregated computer conferences supporting an online course. The training was based on both the academic literature on educational computer conference moderation and situational examples taken from the experiences of online moderators. The students' experiences with the trained moderator were compared with those students in the other two computer conferences without a trained moderator. The data analyzed were comprised of the messages collected from the three computer conferences, selected interviews, extensive journals written by the researcher, and an online survey.

The study also considered the problems and pressures stemming from unclear policies for constructing an online course in an environment of overlapping departmental mandates. These mandates resulted in more emphasis being given to putting courses online than the choice of the most appropriate pedagogy.

The results indicated that a trained moderator had a positive effect on computer conferences as a community of support and warmth was built; while another group, without such a moderator, constructed a community based on group dissent. No community of any sort was found in the third group.

Overview of the Problem

The rush to get online can find teachers in the position of having an excellent command of classroom pedagogy but without a full complement of the skills needed to make the most of the technologies and conventions of online distance learning. It is not unusual for there to be no clear policy to educate teachers in this regard. Frequently asynchronous Internet courses contain a computer conference wherein the class can communicate with each other. A computer conference is used as an online equivalent of classroom discussion, a place where students can participate in collaborative work and carry on other activities. Historically, the moderating of such conferences have been the responsibility of the teacher or assigned to a student to manage (Murphy, Cifuentes, Yakimovicz, Segur, Mahoney, & Kodali, 1996). An incorrect but frequently made assumption is that the ability to lead an exhilarating classroom discussion translates well to leading an online discussion. A common occurrence in computer conferencing is that the teacher poses a few questions to the group, and no one responds. Often, the conference becomes unused to the bewilderment of the teacher. Managing interaction in a distance learning environment requires different skills than in a traditional classroom (Inman & Kerwin, 1999).

It is widely assumed that students will use an online conferencing system just because it is available. This is not the case. The Apple Classroom of Tomorrow study put computers in schools for ten years as an exploratory experiment. Researchers believed that merely having technology available would increase learning. They were disappointed to find that it did not. Instead, they found that technology, by itself, does nothing. Rather than being a panacea, technology should be regarded as nothing more than a tool that has the potential to enhance innovative thinking (Sandholtz, Ringstaff, & Dwyer, 1997). It is the same with Internet based instruction.

Students often experience isolation due to the lack of the usual social aspects of a classroom (Ahern, 1995). The immediacy of interactions between instructor and student as well as among students is diminished because asynchronous communication can take days or even weeks between the time a question is asked or a point is made, and the student receiving feedback. This time lag can leave students feeling ignored (Eastmond, 1995). Attrition in distance learning courses is higher than their face-to-face counterparts, sometimes much higher (Carr, 2000; Cheng, Lehman, & Armstrong, 1991; Jewett, 1997; Noble, 1998). Studies report that completion rates of students in traditional face-to-face classes can be as high as 60% greater than online classes. This determined that the use of trained moderators did alleviate a number of these problems.

Intent of the Study

The intent of the study was to explore how the use of a trained moderator affected both the students and instructor of an Internet based distance learning class. The moderator underwent training based on academic literature on educational computer conference moderation and examples taken from the experiences of online moderators.

Limitations of the Study

The limitations of this study were broad and affected the generalizability of its findings. The study involved one course given over one semester. The students involved were unique individuals each taking the course for different reasons. The woman that volunteered to be the trained moderator was under a set of pressures unique to her particular circumstance. The instructor utilized one form of Internet based distance learning that had strong similarities to a correspondence course. There are many other ways of constructing a distance learning course. The specificity of what transpired in the course had a strong bearing on the generalizability of the findings of the study. Qualitative research does not purport to generate universally generalizable findings, but rather to discover and uncover a set of observations, processes, and theories that other researchers can transfer to similar research problems in other situations and fields (Charmaz, 2000; Eisner, 1997).

Writing Myself In

In an interpretive study, such as this, all aspects of the study are filtered through the eyes of the researcher, which in this case was myself. Therefore, it has been common practice to make the interpretive process explicit (Bailey, 1996). Instead of seeming to be a neutral observer without bias, Piantanida and Garman (1999) suggested that it was incumbent upon the researcher to expose biases of the researcher by discussing why the study was personally compelling. Along with disclosure of the research process, personal disclosure helps the reader gain an understanding of my point of view and why certain decisions and interpretations were made. A discussion of what brought me to this work clarifies my point of view as it affected this study.

I have been online since the early 1980s when I bought my first computer, an Apple][+ along with a 300 baud modem. At first, what I found was not only disheartening, it was also boring. In northern New Jersey, the BBS world was inundated with vanity and inanity. Boards were mostly run by spoiled upper middle-class boys between the ages of 14 and 16 who used the venue to pump up their egos. The systems were rife with the collection and transfer of illegal MCI telephone card codes.

The idea occurred to me that a BBS could be a warm and friendly place, appealing to a different group of people than kids skirting the law. I developed the idea of a digital restaurant where people could visit and discuss the news of the day or anything else they had in mind, in a supportive, non-threatening environment. There would be no <u>flames</u> (personal attacks) nor would there be pirating of software. I felt that my bulletin board should reach out to the user, not the other way around, and attempt to be an oasis of intelligence in the suburbs. I bought some BBS software and learned how to twist and turn it into a restaurant named *+ DAVID'S PLACE +*.

When a user logged on, he or she was greeted at the door by a loquacious Maitre'd who profusely welcomed the new user. The user, who was referred to as a guest, was met with a description of the restaurant in paragraphs of purple prose that included everything from the pile of the carpet to the richness of the oak walls. The guest was then seated at a table and proffered the menu, which contained the options that were available for ordering. These, naturally enough, were the features of the BBS software. I was Chef David, who bounded out of the kitchen and again welcomed the guest. My persona was written into each prompt and instead of the usual unfriendly response of <u>?</u> or <u>SYNTAX ERROR</u>, the software, when it did not understand a response would display something along the order of,

> I APOLOGIZE BUT THE BROWNIES JUST BURNED AND THE SMOKE FROM THE OVEN GOT IN MY EYES SO I COULDN'T MAKE OUT WHAT YOU WERE SAYING. WOULD YOU REPHRASE THAT?

I advertised the BBS on some other BBSs and waited for the phone to ring. I did not wait very long. In a matter of weeks, word somehow got out and I had to devote my Apple][+ to the BBS and buy myself a second computer because +* DAVID'S PLACE +* quickly became busy around the clock. A core group of guests were formed, and after being prompted a bit, engaged in discussions on a fairly high plane. The group quickly coalesced into a kind of round-table that did not easily suffer idiots.

I learned that telecommunication was a wonderful medium for building powers of persuasion, organization, and thought. I found that when one wrote a message it tended to be well composed because the process of thinking, typing, and reading turned people into editors who reflected on their thoughts before making them public. There was also an implicit standard of quality that was not taken lightly by the guests. My BBS gave people the opportunity to use telecommunication in a supportive and mentally stimulating atmosphere. Frequenting the BBS taught many people who previously were unfocused and disorganized in their writing, how to write and write well. Through the use of my BBS, I gave many people a reason to become interested in computers and who, years later, wound up with computer science degrees and jobs in the computer industry.

Finding ways to manage personal conflicts and heated arguments among guests did not come easily or naturally. I found myself experimenting with a combination of private email and publicly written messages to douse verbal flames, as some of the stronger, quicker, but painfully antisocial writers tried to rout other guests. This was my first taste of moderating online conferences, I went about it totally through trial and error. Although there were times I came close to just turning off the modem, I considered it a worthy challenge. The experience taught me about using language to manipulate. Manipulate is a charged word. According to the Merriam-Webster dictionary (1998) it can mean, "a): to manage or utilize skillfully" or "b) to control or play upon by artful, unfair, or insidious means esp. to one's own advantage" (p. 708). I preferred the former and used the word in that positive context in this study.

I decided to shut it down when it started to feel like more work than play and quickly found myself on the CompuServe Information Service's MAUG (Micronetted Apple User Group) forums. Eventually I became SysOp (System Operator) of the Macintosh Community Clubhouse Forum (MACCLUB). This forum was languishing and had nothing to recommend itself aside from being the place that housed the classified advertisements. It logged an average of seven or eight messages per day. I saw it as an opportunity to reincarnate *+ DAVID'S PLACE +* on a larger scale, so I restructured the forum by getting rid of the dusty ill used message topic sections and libraries and filled it with things that excited me and that I felt would excite the Macintosh community.

After a few weeks, an average day brought over 100 posted messages. After a few months a typical day brought 250 messages which, during periods of heat and passion, grew to over 500 postings daily. This was a very creative and exhilarating time for me. I quickly learned what worked and was quick to change anything that did not work. Under the basic rule, it was allowable to attack ideas posted in a message but it was not allowable to attack the person who wrote the message. This basic rule prevented many online flames but when a flame did occur, it took creativity and wit to quell it without resorting to banishing the offending writer from the community. No one was ever sent away. My 15 years of involvement online taught me much about what builds or destroys online communities.

I decided to rejoin academia and began to read the research on educational computer conferencing written over the same 15-year period. I was not surprised to find that most researchers had discovered exactly the same concepts through research that I had found through practicing my hobby. After returning to academia I soon realized that I did not have the time to devote to the community, so I ceased being its moderator.

Most people who have moderated online conferences learned by observing other moderators and then through the trial and error of doing it (Berge & Collins, 1998; Collins & Berge, 1997). At the start of my doctoral work, a vague and shapeless idea occurred to me that learning how to moderate by trial and error was very inefficient and that the skills of a moderator were something that could be taught. As I progressed through my program of study and learned more about distance learning in the context of Internet based delivery and computer conferencing my ideas clarified and resulted in this study.

Research Procedures

Qualitative Research

This study used a variety of qualitative analysis techniques to attempt to clarify a series of situations that, during data collection and analysis, widened in scope and complexity as new issues arose and became integral to the story. Miles and Huberman (1994) maintained that qualitative research is more of a craft than a set of rules and that no study conforms perfectly to a predetermined methodology. Any methods that afford clear and "credible meaning from a set of qualitative data is grist for our mill regardless of its antecedents" (p. 3).

Attempting to define qualitative research is a bit like trying to describe smoke. It seems easier to explain what it is not than what it is. According to Savenye and Robinson (1996) it is marked by rich and detailed descriptions of the behaviors of people who, in their actions, construct their own realities that influence the meaning of their actions. It questions just what is going on and what variations can be found in the phenomenon being examined (Lofland, 1971).

Participants and Conference

The students were 30 upper level undergraduates enrolled in ICJ-450, Implications of Supreme Court Decisions on Law Enforcement at a large Southwestern University. The gender distribution of the class was 21 women and 9 men. I decided to break the class into three conferences that were called law firms due to the context of the subject matter. Each conference was restricted to reading and responding to messages within the particular conference assigned to the student. The initial design called for one conference to be lead for the entire semester, by a moderator who would undergo training consisting of both face-to-face training and a written job aid of my design For the other two conferences, one student each week would be assigned the job of moderating. Due to the Instructor failing to communicate with students regarding moderating the two conferences without a trained moderator, most weeks, any moderating activities in these conferences was ad-hoc. The class used the FirstClass conferencing system.

Structure of the Course

The way that Stanley Pike, the Instructor, structured the course was not very conducive to interaction. Each week the students were required to read a number of supreme court decisions, answer questions about them and send the results back to the Pike who would send a one line email detailing it the work was sufficient or needed to be redone. There was no student-student interaction built into the course and the student-teacher interaction was quite minimal. The course was conducted via distance once before I got involved and the conferencing, although there was presented as something for the students to use if they chose. The messages may or may not be read by Stanley. The result was a total of four messages written over the entire semester from a class of approximately 30 students.

Data Collection

Data were collected from 763 online messages, which were written by the members of the three segregated computer conferences. My role was that of an observer. Throughout the study I wrote detailed memos explaining the process and my perspectives on what had transpired. Detailed coding memos were also written as the data were analyzed. Data were also provided by email and phone conversations between myself and the trained moderator; Rob Janesh from the College of Distributed Education; Barbara Malik, the technology support analyst from the School of Legal Services; and Stanley Pike, JD, the instructor of the course. After the end of the course I conducted audio taped interviews with each of these people; the transcription of the tapes added to the data. Near the end of the course, an online survey was completed by 22 of the 30 students who finished the course.

Data Analysis

I used a combination of grounded theory and narrative analysis to interpret and describe the data. The thrust of grounded theory is toward developing theory without regard to the type of data, or lines of research, which makes it not a method or technique, per se. Instead, it is a "style" of engaging in qualitative research that includes a number of distinct features and guidelines, such as using constant comparisons and a paradigm of coding to ensure the development of concepts (Strauss, 1987). In assessing a grounded theory, the research process must be explicated and conform to the rather broad requirements of the constant comparative method such as engaging in comparisons between data as soon as data is collected. For the study to be considered adequate, the resulting theory should fit the phenomenon studied and be general enough to broadly cover a range of situations (Wells, 1995).

Although grounded theory began as a postpositivist mode of inquiry, when it is subjective and relativist, grounded theory can evolve to fit a constructivist perspective (Annells, 1996). Charmaz (2000) proposed a constructivist approach to grounded theory that does not attempt to find truth that can be generalized, instead its use is to generate concepts that can be transported to similar problems in other fields. An interpretivist mode of grounded theory was used in this study. To assist me the in massive task of analyzing 763 text messages posted to the computer conferences, I coded useing the software program QSR NUD*IST. The acronym stands for Non-numerical Unstructured Data Indexing Searching and Theorizing (Qualitative Solutions and Research Pty Ltd., 1997). NUD*IST is a program designed for the flexible storage, coding, retrieval, and analysis of text. Weitzman and Miles (1995) declared that it is one of the best software options available. They contend that the developers did a masterful job of determining and providing for the actions and features required for a wide variety of text analyses. After a sizable number of iterations of coding one major criteria emerged: 'What built or destroyed community'.

Narrative research refers to any study that analyzes narrative materials (Lieblich, Tuval-Mashiach, & Zilber, 1998). It is a form of qualitative analysis using plot and stories to describe events and situations and has a variety of meanings and procedures dealing with how protagonists interpret things (Bruner, 1990; Riessman, 1993).

Polkinghorne (1995) divided narrative research into two classes: paradigmatic and narrative construction. Narrative construction is not merely a retelling of the actions and thoughts of the protagonist; it attempts to bring meaning and significance to them. The researcher, in this form of narrative inquiry, is the narrator who tells the story in his or her own voice. The paradigmatic type of narrative research produces knowledge of concepts that classify instances to categories with shared common attributes. Paradigmatic narrative research has apparent similarities to grounded theory. Often referred to as analysis of narrative, the researcher inspects a number of stories to discover connections and similarities between them.

The presentation of analysis of narrative often takes the form of extended quotations from unedited data, along with the stories leading up to the data, and attempts to analyze what took place through the perspectives of the commonality emergent from the data under study and varied other data. This study uses both types of narrative.

Struggling Toward the Firms

The course almost didn't get offered due to serious medical problems experienced by the Instructor which prevented any preparation or moderator training before the first day of class. A grad student that I was promised to take on the role of the moderator dropped out and I was left with trying to convince a student to take on the daunting task of moderating. Mimi Denomme did volunteer but a month passed before the training could take place due to her out of class responsbilities. She had three small children, a full time job and was taking three other classes. This gave her next to no time for moderating. I was quite frustrated and disappointed with the amount of time and effort that Mimi devoted to moderating, but I certainly understood the underlying reasons for this lack of participation.

Stanley Pike was not sold on the idea of interaction being a long time lecturer who easily fell into the correspondence course model of distance leaning. He neither received or solicited any training in the differences between a face-to-face course and one conducted at a distance. Stanley felt that he had put enough time into the course by being required to send short emails.

It was a full month after the start of the course before the conferences started, and two weeks after that that I convinced Stanley that a participation requirement was a critical component of conferencing. Hacker and Wignall (1997) observed that participation of students with low degrees of computer experience declined significantly over time. Therefore, a minimum level of participation should be mandated at the start of the conference. This can be accomplished either by establishing a written or verbal contract between the moderator or teacher and the students (Rohfeld & Hiemstra, 1995). Eastmond and Ziegahn (1995) maintained that along with mandating a certain number of messages per week, that there be standards established for the quality and relevance of the messages. They suggested that participation accounted for 30% of the course grade. It has also been proposed that the amount and quality of participation should be able to raise or lower assessment by a full letter grade (Cifuentes, Murphy, Segur, & Kodali, 1997). Many conferences take time to get established and spark general interest to the extent that the members need no incentive to post messages; therefore, it is important to establish a mandate to give the conference time to come into its own.

Results

Mimi tried her hand at welcome messages for each of the three-conferencing spaces within her conference (Firm two). I decided that three spaces made sense from an organizational perspective and to eliminate confusion on where to post. What was developed was The Coffee Shop, a social space, The Board Room, a content oriented space and The Tech Room, a place for technical problem solving. Each of the other two groups only had one group space.

I gave Mimi feedback on my feelings on what would work and provoke discussion and what wouldn't. Soon we agreed upon three messages that would suffice.

The number of messages posted per week shed some light on the scope of the firms and serves a point of reference and departure.

Figure 1. Total postings per week in each firm

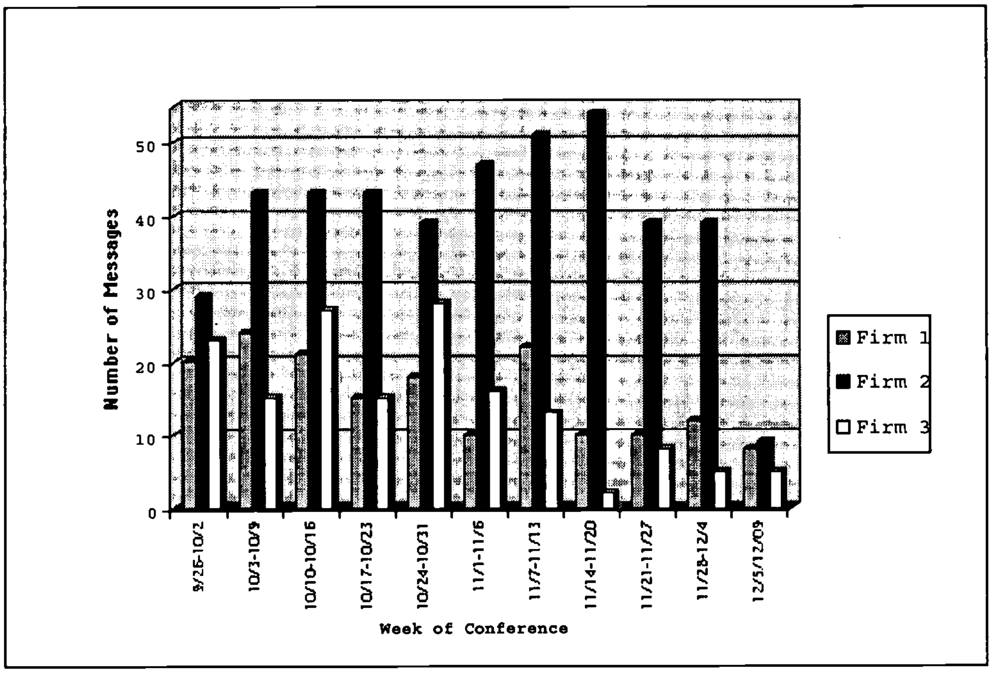
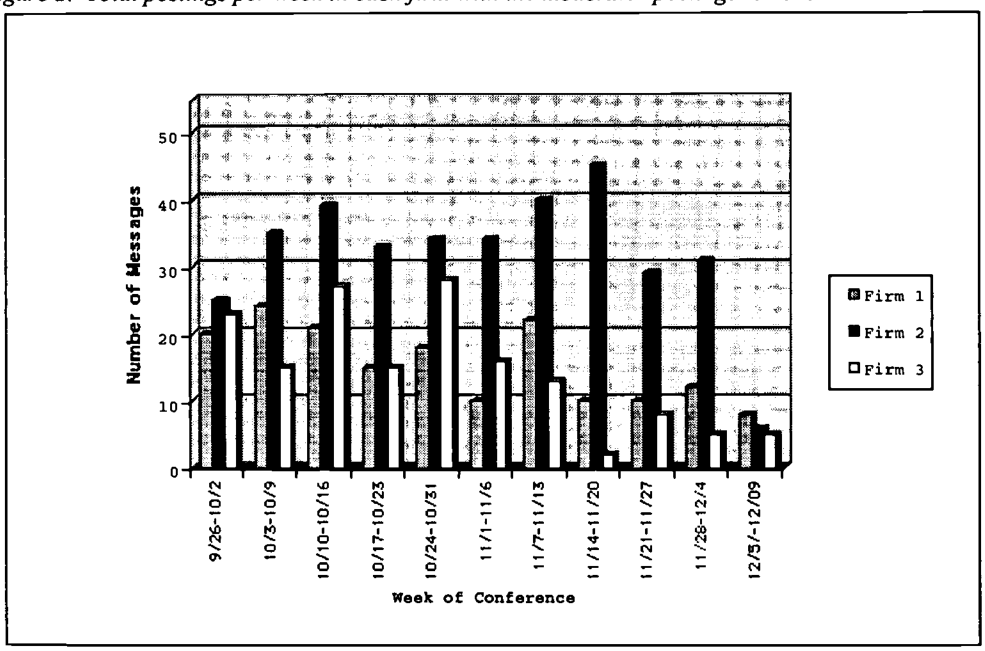


Figure one shows many more messages being posted in group two (the group with a trained moderator than the other two groups, but one might easily see a flaw in this by positing that the majority of messages were written by the moderator.

Figure 2. Total postings per week in each firm with the moderator postings removed.



Subtracting the firm 2 moderator messages from total messages still shows many more messages posted to firms two than in the other two firms. What happened in the firms to make such a difference?

Firm One

At the start of data collection, firm 1 demonstrated no particular leadership. Messages were concerned with organizational issues such as questions dealing with due dates for assignments and questions regarding grading procedures. A number of people were confused regarding what was expected of them and how to find Supreme Court cases required for homework. There was one thread that went on for a number of weeks, soliciting employees for a security firm. This thread upped the message count considerably. Overall, there was no focus to this firm in the first few weeks. The threads were mostly concerned with asking single questions and receiving single answers. There was quite a bit of talk about how much harder the course was than what was expected, which also became a major concern in other firms.

Within a few weeks the firm evidenced a strong sense of pointlessness of participating in the discussions whether it was for credit or not. Since the firm was not in any way integrated into the class, the majority of participants considered it a waste of time and by the end of the course, the people who did participate, and that number dropped every week, were posting messages without any content just because it was a requirement.

> DO NOT WASTE YOUR TIME READING THIS!! I'm just sending an email to fulfill the three-a-week requirement. Unfortunately I have nothing to say or ask, so I am writing about my writing about nothing.

Soon thereafter, most message traffic from Firm one stopped due to no purpose, no leadership and no momentum.

Community was not built in firm one since the participants never found a center or any salient reason to be there at all. It was generally considered a waste of their time.

Firm Three

During the first week of messaging Karla Schwartz asserted leadership of group. Karla had a strong personality and quickly fomented discontent with the amount of homework that the class was responsible to accomplish each week. Although the group had no indication that the Instructor was not reading the messages Karla started a thread entitled 'Dr. Pike is Insane', making the point that the workload is totally unreasonable. This is a part of a representative message from Karla:

> I am sorry but I must vent again. I am absolutely sick of this sh*t. I have answered 18 questions and I still have like 15 to go. This is absolutely ridiculous and I am SICK OF IT! This class is taking up my whole goddamn life and I do nothing but work and come home and work on this sh*t.

This created a mob mentality where everyone seemed to jump on the 'bandwagon' and state that they also weren't going to take it. The class decided to distribute answers to their take home midterms and discussed emailing each other long homework assignments where they intended to change the wording so it wouldn't appear as plagiarism. These messages were posted in public forums demonstrating uninhibited behavior that many researchers have noted as being a inherent in asynchronous communication.

Eventually the workload was decreased and message traffic lessened to the point of being nearly non-existent. Since there was nothing left to complain about, they had nothing to say.

Community was built in firm three, but not the sort proposed by advocates of online learning. What built this community was group dissent and communal complaints lead by Karla Schwartz and fomented by the members of the firm that posted messages. During the week of the midterm eight people posted, followed by seven people just before Dr. Pike changed the assignments. Once the change was made only four people posted. Once there was nothing left to rally around, everyone seemingly packed up and went home. There was nothing left to talk about.

Firm Two

The amount of intervention by the moderator was much less than what I, at first considered adequate, the conference started quite late into the course the conference was generally well received and an enjoyable and helpful addition to the class. An interesting side-note is that in interviewing the Instructor, his opinion was that the conferencing had nothing to do with the class, most of the attitude surveys from members of Firms two stated that the messaging was well integrated into the class.

Community was built in firm two. There was a heavy social use of The Coffee Shop section that the firm used to connect and form relationships. There was a large amount of personal information revealed as an ongoing

system of empathy and warmth was developed. What built the community was the construction of a warm and friendly atmosphere prompted by Mimi, and the camaraderie that grew out of what became a place to come for support friendship and humor.

Summary

This study attempted to explore the effects of a trained moderator in an asynchronous distance learning class. The study was designed to use grounded theory and narrative research to report on the experiences of a graduate assistant expected to be trained as a moderator, and the members of the computer conference managed by the moderator. These experiences were to be compared with the experiences of two other segregated computer conferences, each run by a moderator that would change each week. These moderators would receive no formal training of any sort. The computer conferences were to support a distance learning course offered by the School of Legal Services at a campus of a large southwestern university.

The study almost did not take place due to a litany of problems, including the graduate assistant meant to undergo the moderator training dropping out, the instructor experiencing life-threatening medical problems, and a course that was previously devoid of any form of interaction among the students. The instructor, a long time lecturer, had no distance learning training and the resulting class resembled an electronic correspondence course with little regard given to student-student interaction.

A student volunteered to undergo training and moderate one of three-segregated computer conferences for the semester. Time pressures and other commitments prevented her from practicing a number of the techniques of good conference moderation. It became necessary for me to be in constant contact with the moderator, heavily guiding her actions until late into the semester. The other two-segregated computer conferences did not employ moderators due to technical complications.

The study found that even with a low degree of intervention the use of moderation techniques allowed the moderated group to form a community based on camaraderie, support, and warmth. Conference messages in this group amounted to over 2.5 times that of the next highest group. It was also found that structuring places to post messages by dividing the conference into a content oriented space, a social space, and a technical space had positive implications, which assisted and at times became a substitute for certain moderation techniques.

Analysis of the other two groups found one group forming no community whatsoever and the other group forming a community based upon group dissent and communal complaint initiated by a strong personality and what the group considered an inordinate amount of work. This group demonstrated extremely uninhibited behavior using words and concepts that would be inappropriate in a classroom situation.

In a discussion of how online courses are constructed on the campus under study, it was discovered that there was a wide variety of overlapping options that could easily become confusing. Major emphasis was given to putting courses online while little thought was given to the appropriateness of the pedagogy that should be employed.

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USING THE BIG SIX INFORMATION SKILLS AS A Metacognitive Scaffold TO SolvE Information Based Problems

Sara Elizabeth Wolf
Auburn University

Thomas Brush
Arizona State University

Abstract

The purpose of this research study was to determine whether a specific information problem-solving skills model was an effective metacognitive scaffold for students solving information-based problems. Specifically, thirty-five eighth grade students in two intact classes were asked to write newspaper articles that summarized the events surrounding the Selma March during the African-American Civil Rights Movement. Achievement and attitudinal data were collected at the end of the treatment period, and observational data were collected throughout the treatment period. One class of students followed the procedures of the Eisenberg and Berkowitz Information

Problem Solving model while the other followed the procedures provided by the classroom teacher. Results revealed that the students following a specific metacognitive scaffold performed better on the achievement measure. However, the students using a teacher-managed process reported more positive attitudes than the scaffolded students. Possible reasons for the differences in reported attitudes between the two groups include differing responsibility levels of students and teachers within the groups as well as differences in time spent in on-task behaviors throughout the study.

Introduction

Information literacy has been a topic of research for a number of years. Through the examination of searcher behavior, several models have been developed that describe the processes used by people who are seeing information (Eisenberg & Berkowitz, 1990; Kuhlthau, 1983; Stripling & Pitts, 1988). Organizations such as the American Association for School Librarians and the American Library Association have collaborated to develop standards for information literacy. These standards call for students who access information efficiently and effectively, evaluate information critically and competently, and use information accurately and creatively (American Association of School Librarians, 1998). Students who use information in this manner to explore and solve problems are identified as being information literate. It has been noted that students need various resources, tools and scaffolds to support their efforts to solve the educational problems they encounter (Hannafin, Land, & Oliver, 1999; Hannafin, Hall, Land, & Hill, 1994). The role that scaffolding plays in student achievement has also been explored (Saye & Brush, 1999; Hannafin et al., 1994; Hannafin, Hannafin, Land, & Oliver, 1997a). This study sought to enrich the body of knowledge concerning the role of metacognition and metacognitive scaffolds in supporting student research activities.

Metacognition

Metacognition has been described as thinking about thinking. More specific definitions include references to knowledge and control of factors that affect learning, such as knowledge of self, the task at hand, and the strategies to be employed (Baker & Brown, 1984; Palincsar & Brown, 1981). In order to perform metacognitively learners must be able both to be aware of their own cognitive activities, and to control and monitor that cognitive activity. The distinction between awareness and control was examined in order to determine what differences existed between learning disabled and non-learning disabled students. Slife, Weiss, and Bell (1985) found that when these two groups of students were compared in metacognitive skill activities, the differences were in metacognitive strengths rather than skills deficiencies.

McGregor (1993) examined the thinking processes that students engaged while writing research papers. She found that students seemed to be unaware of their own cognitive processes. That is, "students do not instinctively operate in a metacognitive manner" (McGregor, 1993 p. 131). Other researchers have found that student success in a learning environment is impacted by the lack of metacognitive ability of the students (Hill, 1995; Land & Hannafin, 1997). This lack of metacognitive skill and awareness supports the need for instruction

that teaches learners to "plan, implement and evaluate" (Palincsar, 1986 p. 123) strategies for learning and problem-solving.

Scaffolding

How can teachers provide the instruction students need in order to develop strong metacognitive skills that are inherently difficult both to observe and teach? One way is to incorporate the use of scaffolds into the curriculum. While the basic concept of scaffolding has been defined as a support structure for learners engaged in activities just beyond their independent abilities (Vygotsky, 1978), some have further delineated differences between specific types of scaffolding. Hannafin et al. (1999) identified four different types of scaffolds, metacognitive, procedural, conceptual, and strategic. Figure 1 provides an overview of these scaffold types and the situations where they might be used.

Scaffold Type	Description	Used when...
Metacognitive	Guidance in what to think during a learning activity	Students are engaged in an independent metacognitive activity such as research-based problem solving
Procedural	Assistance with a particular tool or feature of a learning environment	Technology is being utilized; job aids are needed
Conceptual	Assistance with what to consider; Vygotskian scaffolding	The various possible methods for achieving success can be known ahead of time by the teacher
Strategic	Guidance in the approach that might be needed in a learning situation	Alternative strategies have not been considered by students; participation in planning and implementing decision making skills in open-ended learning environments.

Figure 1. Scaffold descriptions and uses

Research indicates that how scaffolds are used in various learning situations has impacted student achievement and attitudes (Saye & Brush, 1999; Hill, 1995; Krajcik, Soloway, Blumenfeld, & Marx, 1998). For example, Oliver (1996) and Brush and Saye (2000) both found that the use of a scaffold rather than its presence impacted student success within a particular learning situation. Other researchers (Hill, 1995; Land & Hannafin, 1997) suggest that deficiencies found in student metacognitive skill could be mitigated through the use of strong metacognitive scaffolds. In addition, the school library community has recognized the need for students to posses strong metacognitive skills.

Information Problem-Solving

Within the school library media community several researchers have studied searcher behavior in a variety of contexts, including print (Dreher, 1993; Dreher & Sammons, 1994), Electronic (Marchionini, 1989), and multimedia (Perzylo & Oliver, 1992) environments. Others sought to describe the search process in descriptive (Kuhlthau, 1993), and prescriptive (Eisenberg & Berkowitz, 1990; Stripling & Pitts, 1988) ways.

A common theme through the research on information seeking involves the need to increase the metacognitive skills of students. A general metacognitive scaffold is needed so that students do not have to rely on situation specific scaffolds each time they encounter a problem or unfamiliar situation (Costa, 1984). Several information problem-solving models exist (Kuhlthau, 1983; Stripling & Pitts, 1988; Eisenberg & Berkowitz, 1988) that could function as metacognitive scaffolds. The Eisenberg and Berkowitz Information Problem-Solving (IPS) model is well suited for use in this capacity. Figure 2 provides an illustration of the IPS model. Each step or task is comprised of two sub-tasks that students should accomplish in order to use information in an effective and efficient manner to solve educational problems.

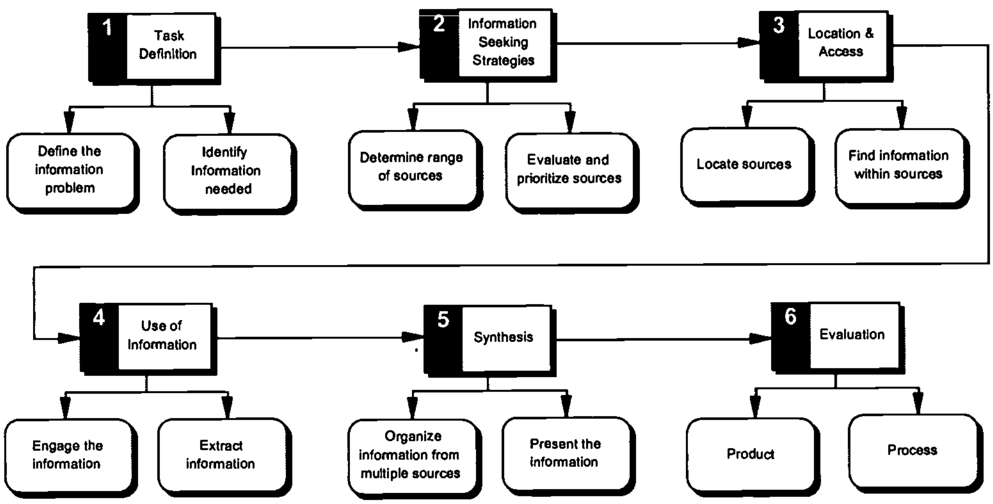

Figure 2. The Big Six Information Skills (Eisenberg & Berkowitz, 1990)

Integrating Scaffolding, Metacognition and IPS

The implementation of an information problem-solving model involves more than teaching students a series of steps and directing them to the research materials in the library. In order for learning to occur in these situations, students must actively interact with materials and information in such a way as to construct their own meaning from the interaction (Kuhlthau, 1993). However, as has been previously noted, this does not always occur particularly with student who are unfamiliar with the research process (McGregor, 1993; Perkins, 1991; Steinberg, 1977, 1989). However, if the "purpose of strategy instruction is to influence how the learner interacts with the learning situation" (Palincsar, 1986 p. 118), then the use of IPS as a metacognitive scaffold is warranted.

There are many references to the Eisenberg-Berkowitz IPS model on the World Wide Web and in the literature read by professional school library media specialists. While this body of anecdotal evidence is compelling as to the far-reaching effects this model has had on educational practices, it is lacking in rigorous research to support the conclusions presented. The only research that discusses the impact this IPS model might have on student achievement was conducted by the authors of the model (Eisenberg, 1999; Eisenberg & Berkowitz, 1998). This case study reported an improvement from 53% to 95% of students passing a high school American History examination over a period of one year.

While a variety of research has been conducted in order to understand the information seeking behaviors of searchers (Kuhlthau, 1991; Marchionini, 1989; Stripling & Pitts, 1988) and there has been an identified need to strengthen metacognitive skills in students (Hill & Hannafin, 1997; Brush & Saye, in press; Oliver & Perzylo, 1994) a detailed examination of the effectiveness of particular information problem-solving models has not been conducted. If a particular model were shown to be effective in strengthening metacognitive skills in students several of the performance gaps identified in research could be addressed. Students would effectively and efficiently access and use information, students would monitor their own thought processes, teachers would design effective scaffolded problem spaces, and students would begin to transfer problem-solving skills from one academic situation to another.

Method

Thirty-five students in two eighth-grade social studies classes in a major southwestern city participated in the study, divided equally between male and female genders. The researcher acted as both participant and observer during the course of the study by conducting one of the classes for the students and providing technical support for the participating teacher while he conducted his class. The participating teacher conducted the other class for the study according to his established classroom procedures. Students in this study were provided with their own computer (either a laptop or a desktop system) to use for research activities.

A two group (scaffolded vs. non-scaffolded), quasi-experimental design was implemented to determine achievement differences within this study. One group (scaffolded class) received training and guidance in the use of a specific IPS model while completing their reports and the other group (non-scaffolded class) received no explicit IPS training. Each student completed a 15 item, multiple choice pre-test prior to the onset of the study. Items covered knowledge-level information about the Selma March as well as the African-American Civil Rights

Movement. Subject matter content was delivered via *Decision Point!* (DP), an "integrated set of multimedia content resources and tools" (Saye & Brush, 1999, p. 11) relating to the African-American Civil Rights Movement. Restricting the activity to a single event allowed the researcher to control the problem space students engaged while allowing students relative freedom to explore an even however they deemed appropriate (Oliver & Perzylo, 1994; Saye & Brush, 1999; Yang, 1997). The researcher created job-aids for all participating students to use during the study activities. These procedural scaffolds (Hannafin et al., 1999) helped students maintain focus and remain oriented in the open-ended environment.

Students in the scaffolded class were provided with an additional job-aid to remind them of the steps involved in the information problem-solving process (see figure 1). Some elements of this metacognitive scaffold were incorporated directly into DP through the "guides" and "journal" tabs of the electronic notebook. While these scaffolds were available to all of the students, only the students in the scaffolded class were explicitly told to use them. "Guides" questions consisted of a series of questions organized around the five questioning words associated with news article writing (who, what, where, when, why). The journal contained prompts for the students to complete that provided guidance in thinking about their own progress, and in making a plan for the next class meeting day.

The study was conducted over 11 class days, with one additional class day being used for the administration of the study pre-test. The participating classes met on alternating days, beginning each Monday. Classes that met on Monday or Wednesday lasted 85 minutes, while classes that met on Friday lasted 35 minutes. Prior to the beginning of the study one of the classes was chosen to receive the scaffolded activities. The other class received instruction that the classroom teacher designed and felt was appropriate for the unit as a whole.

One week prior to the beginning of the study activities the researcher visited the classroom in order to acclimate herself to the regular activities for each class. During this week the researcher administered the pre-test to the students. Although the scaffolded class scored slightly higher (M=4.5) than the non-scaffolded class (M=4.0) a Mann-Whitney analysis of the pretest scores indicated that there were no differences in prior knowledge between the two groups, $U(18,17) = 116.50$, $\underline{p} = .36$. Upon completion of the pretest, an introductory activity was conducted with both classes. The activity consisted of a short scavenger hunt using the DP software. This helped insure that students were familiar with the basic components of the event that they investigated as a part of their final activity. After completion of the scavenger hunt, the structured unit activities began.

Each class received a different first activity to begin the study. The first activity for the scaffolded class was an information problem-solving training session. The orientation focused on the IPS process students were asked to engage during the study activity. The first activity for the non-scaffolded class was an introduction to newspaper article writing, conducted by the teacher. Once each class completed their orientation activities, the students spent three class days collecting information related to the Selma March and creating their initial (rough-draft) reports. They were given two class periods to make final revisions to their work. Students in the scaffolded class determined their own methods of information gathering with only mild guidance from the researcher.

Students in the scaffolded class began their study activities by determining exactly what was being asked of them. They then generated lists of questions that they could use to answer and fulfill their article requirements. Once the questions were generated students sued the DP database to find answers to their questions. They also used the questions in the Guides section of the DP notebook to focus their research. Once the students finished answering their own questions and those featured in the guides questions, they used that information to create a handwritten rough draft. Students then used the scoring guide to evaluate their neighbor's article. Students took those comments and made revisions to their work and submitted the final form of their article. The teacher guided his students during the newspaper article writing process according to established classroom procedures. After the initial introduction to the structure of news articles the classroom teacher told his students to "find the information you need in order to write your articles." Students turned in handwritten rough drafts that the teacher took home to edit. The next class period, he returned the rough drafts to the students so that they could make the indicated changes. Students turned in their final copies with an attached picture on a separate piece of paper.

The articles that the students created were news articles that reported on the events surrounding the Selma March. Students in both classes submitted the reports in written format. As a part of the IPS scaffold, students in the scaffolded class were given the criteria for grading prior to their submission of the assignment. The reports covered the following elements of the Selma March: a general overview or timeline of events, key people involved in the event, causes of the event, and results of the event. Observers took field notes and audiotaped each class session in order to collect qualitative data concerning student engagement, attitudes, and behaviors during the information problem-solving process. After each of the classes the teacher and researcher conferred for a short debriefing session. During this time the teacher had the opportunity to discuss any significant occurrences that the researcher may have missed during the class session and share his impressions of student attitudes and progress.

All of the students participating in the study completed exit surveys during the final class period. The 4-point Likert-type survey collected attitudinal data from the students, such as the students' feelings about the unit, the topic, their preferred way of learning social studies information and their feelings about future research projects. In addition, students were asked to respond to open-ended questions regarding the elements of the project they liked and disliked as well as whether they would recommend the project to their peers. Following the submission of student reports the researcher conducted exit interviews with selected students. The classroom teacher recommended students for selection based on their willingness to be interviewed and their ability to express and elaborate on their thoughts. The interviews were conducted in pairs to help alleviate any anxiety associated with the interview process as well as to gain a more complete understanding of what the student knew regarding the research study (Graue & Walsh, 1998). Interview questions were based on journal entries and observations from class sessions. Students were asked to explain and expand on comments made in their journals, to verify assertions made during classroom observations, and to give their opinions about the study activities.

Two neutral scorers used the evaluation rubric to assign scores to each report. To help ensure inter-rater reliability each scorer independently scored each report and then compared their ratings. If the scores were highly divergent the researcher conferred with the scorers to clarify any confusion about the rubric, and how to interpret student reports so that subsequent grading would have a higher level of agreement between the two scorers. At the conclusion of this procedure the correlation between the two groups of scores was .91.

Results

Both quantitative and qualitative data were collected during this study. Results as they pertain to data types are discussed below.

Newspaper Articles

A Mann-Whitney test of the report scores revealed that there were significant differences between the report scores for students in the scaffolded ($\underline{N}$ = 18, $\underline{M}$ = 12.72, $\underline{SD}$ = 1.64) and the non-scaffolded ($\underline{N}$ = 15, $\underline{M}$ = 11.00, $\underline{SD}$ = 1.36) classes, $U(18,15) = 61.00$, $\underline{p}<.01$.

Student Questionnaires

Table 1 provides an illustration of student responses to selected questions from the attitude survey ($N_{non\text{-}scaffolded}=17$, $N_{scaffolded}=18$). Responses were provided on a four point Likert-type scale and then coded as either agree or disagree for analysis purposes. Chi-square analyses were conducted on each item to determine differences in attitudes. There were significant differences in the attitudes of the two classes regarding items "I felt smart while doing the project," $\chi^2(1,N=35)=6.89$, $\underline{p}<.01$ and "I would like to do more projects like this on other social studies topics" $\chi^2(1,N=35)=5.93$, $\underline{p}<.05$. There was also consensus on several other survey items. The majority of students in both classes disagreed with the statements: "This project made me feel nervous" and "This project made me feel dumb." Also, the majority of students in both classes agreed with the statements: "This project helped me understand The Civil Rights Movement better than if I had just read about it in my textbook," "I felt comfortable researching topics I know little about," and "I felt comfortable writing my newspaper article about the Selma March."

Open-ended questions asked students to provide for the researcher things they liked best and liked least about doing the project; ways to improve the assignment; things they would have liked to have more time to do; and whether they would recommend this project to other eighth grade students. Students from both classes liked the computers and the software that they used for their activities. The next most popular answer was that they liked learning about the Civil Rights Movement. These answers included responses referring to the era, the decade, or the event. Other comments included references to the lack of homework during the unit activities, the format of the product they produced and being able to do something different, or at their own pace. However, the scaffolded class mentioned the research process in greater numbers than did the non-scaffolded class.

When asked what they liked least about the unit, the most common answer from both classes concerned the physical act of writing the paper. Students were unable to use a word processor to write their papers because 14 of the 18 students in each class were using laptop computers that wee not connected to the single classroom printer. There were also two sets of students who did not like aspects of the technology used and aspects of having observations conducted in their classrooms. Most students in both groups responded that they would recommend this project as well as similar ones to other eighth grade students. Their reasons ranged from "because it was fun and interesting" to "it is an important event for people to learn about."

Table 1 Student Attitudes.

Statement	Class Scaffolded Agree	Scaffolded Disagree	Non Scaffolded Agree	Non Scaffolded Disagree	χ^2
This project made me feel nervous.	11.1% (2)	88.9% (16)	11.8% (2)	88.2% (15)	.00
I felt smart while doing this project.	38.9% (7)	61.1% (11)	82.4% (14)	17.6% (3)	6.89**
This project helped me understand The Civil Rights Movement better than if I had just read about it in my textbook.	77.8% (14)	22.2% (4)	88.2% (15)	11.8% (2)	.67
I would like to do more projects like this on other topics in social studies.	50% (9)	50% (9)	88.2% (15)	11.8% (2)	5.93*
I felt comfortable researching topics that I know little about.	83.3% (15)	16.7% (3)	82.4% (14)	17.6% (3)	.01
I felt comfortable writing my newspaper article about the Selma March.	76.5% (13)	23.5% (4)	82.4% (14)	17.6% (3)	.18
This project made me feel dumb.	11.1% (2)	88.9% (16)	11.8% (2)	88.2% (15)	.00

*$p < .05$; **$p < .01$

Classroom Observations

During periods of direct instruction, students in both classes demonstrated their understanding of the proper behavior of a school classroom. They raised their hands, tended not to speak all at once, and listened to the comments of their classmates. Also, when they knew the answer to a question from a classmate they were fairly quick to answer and provide help.

During periods devoted to research activities students in the scaffolded class exhibited behaviors that suggested they were more self-directed in their activities. Students in the non-scaffolded class, however, spent the majority of their writing time traveling back and forth between their desks and wherever the teacher was standing. They were less willing to make decisions on their own and relied on the teacher to do the majority of their editing.

Students in both classes asked many questions that were focused on the technology of the DP database. These questions ranged from "Why don't my movies plan?" to "How do I get to do the typing party?" Any questions of this type were answered by the researcher, regardless of which class was in the room. Most of the comments made by students in the non-scaffolded class were directed at the teacher. Usually, a student would ask the teacher to review a sentence or paragraph that had just been written and wait for specific feedback from him. Comments between students generally were initiated only when the teacher was extremely busy, and were superficial in nature. For example, a common question students would ask each other was "how do you spell..." Also, they would ask their neighbor how to find a particular video or picture that was displayed on their computers or ask for help with technical issues on the CD-ROM. The majority of the comments directed to the teacher had to do with the physical construction of their final products. Students asked the teacher to "check-over" each sentence as they wrote them. Sometimes, students would ask the teacher to hold their papers and call them when he had finished with the ones ahead of them in line. Students who used his technique for holding their place in line were observed talking about movies, parties, homework assignments from other classes, and other topics that had nothing to do with the Selma March. Once the students reached the teacher the most frequently asked question was, "Is this ok for a lead/title/sentence?"

Students in the scaffolded class also asked each other spelling and technical questions, but they interacted with each other in terms of the content they were exploring. One student was heard to ask, "Who was this Lyndon Johnson?" The reply was, "Duuuhhh, he was the President during all of this stuff!" Students sitting next to each other were observed talking about the information they found in the articles they read during the activity. Usually this was in connection with a question they asked the researcher about specific information they did not understand, or had difficulty finding within the CD-ROM. Students also discussed the social issues they were finding in the videos and articles of the DP database. Two students were heard discussing the video of the attack on the marchers at the Edmund Pettus bridge. They discussed how the video demonstrated elements of racism based on the attacking dogs and police officers only "going after" the African-American people.

During the final portion of the activity the students in the scaffolded group were asked to review their neighbor's reports. Comments during this activity were centered around the structure of the article itself. Several students were heard to say "the green guide [scoring guide] says that you have to have six paragraphs, and you only have one," or similar types of comments. No comments were made about spelling or grammar, only about the physical layout of the articles.

During the two class periods designated as primarily research days the noise level in the class was markedly lower than during any other days during the study. Students in both classes were observed intently viewing their computer screens. The students in the non-scaffolded class were also using notebook paper and pens to take notes. However, these students were observed copying directly (verbatim) from the articles onto their papers. For the most part, students worked independently. Brief comments were made between table partners, but the research process was primarily conducted on an individual basis. Students in the scaffolded class were typing directly into the computer. Upon observation, these students were typing the answers to the Guides questions that were incorporated into the DP database. Usually, their answers were typed in a list format. For example, one of the Guides questions was, "who was involved in this event?" A typical student's entry would be, "MLK, black voters, federal judge, Jimmie Lee Jackson, President Johnson." Some students were seen to be working together to gather the information for their Guides.

Student behavior on the days designated for writing rough drafts was different between the two classes. The students in the non-scaffolded class alternated their activities between writing one or two sentences at a time and waiting for the teacher to check their work. As a result, there were many students walking around the room during this period of time. During the consultations with the teacher most students in the non-scaffolded class would get part of a question out and then the teacher would interrupt and finish it, or provide the answer to their question without letting them finish. Many times, the teacher would write directly on the students' papers with the wording that he wanted them to use and they would copy it verbatim into the next revision of their article. In most cases the teacher was in possession of the student's paper and pencil during these consultations.

These behaviors contrast with those observed during the scaffolded class. During the days designated as writing days, these students were observed going back and forth between the computer and their papers. While they did consult with the researcher, she maintained a different relationship with the students than observed in the non-scaffolded class. When students asked, "Is this an ok title?" or "Is this all right so far?" the researcher replied, "You have a copy of the exact scoring guide that I will use to give you a grade on the article. You can make those decisions yourself." After answering approximately half of the class' questions like this, the types of questions shifted to content-oriented or technologically-focused ones. During the final evaluation activity for the scaffolded class, the noise level increased, but upon observation this was due to increased occurrences of debate between students. During this activity students were more likely to consult with the researcher to clarify the elements of the scoring guide. After the peer evaluation, students made any corrections to their work that they felt were necessary.

Interviews with the teacher revealed that he thought the unit was generally a success for both classes. He said, "I thought they were interested and engaged." He also noted some differences between the two classes such as attitudes of specific students, time spent in on-task behaviors, and the quality of the work submitted by the students.

Two of the students in the researcher's group were seen by the teacher to be exceptionally interested and engaged with the material. One of these students exhibited what to the teacher was unusual maturity during the completion of the project. Usually this particular student failed to work up to his potential and maturity level, yet still managed to get fairly good grades in school. This student's attitude stood out to the teacher because it was so different from his normal behavior. Other students demonstrated differences in their behavior as well. One student voiced her concern over the quality and correctness of her work to the classroom teacher. "Her paper's decent; it's not great, but she normally, if she doesn't understand, her defense mechanism is to laugh it off and screw around...But she acted like she wanted to do this or was concerned about am I doing this right? Is this good?" A difference the teacher noticed between the two groups was their time spent on-task during the research assignment. "Your group was a little more on task as a whole than mine," said the teacher. He attributed this difference to the difference in presentation styles between himself and the researcher.

The teacher also thought that the quality of the student reports was different between the two groups. Prior to evaluation of the final reports, the researcher asked the teacher to predict whether or not there would be differences in the scores between the two classes. The teacher predicted that the quality of the students in the scaffolded class would be higher than in the non-scaffolded class. He felt that the steps of the information problem-solving model provided a structure that was detailed in such as way as to make failure difficult to achieve.

Overall, the students interviewed from both classes felt that their experience with the unit was a positive one and that they would do something like this again, that the teacher should have provided an overview of the Selma March, and that they wished the content of the news articles were organized chronologically rather than by information type. Differences in attitudes between the two classes were expressed through their perceptions of the newspaper article assignment, what made the unit fun, the role of the teacher, and the types of information within the DP database. The students in the non-scaffolded class felt that writing newspaper articles was a good way to process information and demonstrate their understanding of a topic, but did not like to do it. When the researcher asked students from the non-scaffolded class how they would improve the unit, they focused on providing their

teacher with an assistant. They felt that the teacher was overextended during the study activities. They also spoke strongly about having to wait for long periods of time to get their questions answered about their articles. This paralleled the responses on the exist surveys where one student stated "It would have been better if [the teacher] had time to answer everyone's questions."

Students in the scaffolded class mentioned different aspects of the unit during their interviews. Their comments tended to focus on the research process and differences in the types of information they encountered while conducting research for their newspaper articles. These students indicated that the implementation of the unit was cumbersome to them. They would have preferred to have a single sheet of paper to follow rather than the packet that was provided for them. They also indicated that the steps [of the IPS model] were generic enough that they would try to use them in other classes for other research projects. Students from the scaffolded class also noted that the nature of the information they explored was different than the information they usually used during social studies classes. These students differentiated between the types, and value, of information found in primary sources and in textbooks. They did this despite not having had class discussions about differences between primary and secondary sources. For these students, the primary source documents provided more authentic and accurate information than their textbooks.

Discussion

Using specific information problem-solving models as metacognitive scaffolds has not been widely studied. This research suggests that a particular information problem-solving model might act as an effective metacognitive scaffold for students engaging in complex research-based activities.

Results showed that students who completed research writing activities (newspaper article creation) supported by the IPS model created newspaper articles that were more accurate, utilized a wider variety of information resources, and contained richer details than students who did not have this support. Achievement scores between the two classes of students differed significantly, with the mean achievement score for the scaffolded class being nearly two raw score points higher than the non-scaffolded class. In addition, this study showed that the use of an information problem-solving model increased student engagement, but may have affected the attitudes of students.

There are two potential reasons for the significant differences found in student achievement scores: increased metacognitive activity and differences in time-on-task between students in the scaffolded class and students in the non-scaffolded class. Metacognitive skills such as task analysis, strategy selection, and self-monitoring were strongly supported for students in the scaffolded class. Students in the non-scaffolded class relied on their teacher for support in these tasks, rather than executing the processes themselves. This is illustrated by the role the classroom teacher assumed for his students. The teacher's proposed role, that of "editor-in-chief," was demonstrated while his students were writing their rough and final drafts of their articles. Each student approached the teacher to get his final approval on each sentence or paragraph as they wrote it. This contrasted with the scaffolded class where the students received their guidance and support from the scaffold that the researcher provided to them. Each of the six information problem-solving steps was provided to the students in a booklet that they could use to monitor their own progress. Additionally, it provided them with an explicit process to follow in completing their work. Students in the scaffolded class knew exactly what to do while students in the non-scaffolded class had to ask their teacher for direction at each step of the writing process.

Researchers have claimed that students who can successfully analyze tasks, identify strategies for task completion (Palincsar & Brown, 1981), apply problem-solving strategies in appropriate situations (Eisenberg & Berkowitz, 1990; Palincsar & Brown, 1981) and engage in self-monitoring behaviors (Bondy, 1984) can be considered metacognitively successful. However these skills are difficult for children to acquire (Brown, 1985). Bondy (1984) makes several recommendations to educators interested in strengthening students' metacognitive skills. These include: (1) modeling metacognitive strategies in order to provide students with an understanding of how to mentally negotiate difficult cognitive tasks, (2) requiring students to keep a daily learning log to shift the cognitive focus from product to process, (3) providing instruction in self-questioning techniques to redirect attention, and (4) adapting a learning and studying model to assist students in applying strategies in a wide variety of situations. The relationship between the IPS model and metacognitive skills discussed in the literature was illustrated through the data acquired in the current study.

Gradually, students in the scaffolded class began to understand that the steps of the IPS model could help them understand where they were supposed to be at the end of each day, and where they were supposed to start at the beginning of the next day. Journal entries confirmed this. Except for one student who exhibited extremely high levels of anxiety in relation to the assignments, most students indicated that they were either moderately or highly confident that they knew what to do the next day. Eisenberg & Berkowitz (1988, 1990) argue that the Big Six

Information Skills is a model that students and teachers can use in learning, studying, and problem-solving situations. As such, it can be utilized as a learning or studying model, as recommended by Bondy's (1984).

The second possible explanation for the significant differences in achievement scores was the time-on-task students demonstrated in each class. Due to the more highly defined path and the more frequent opportunities to check their work, students in the scaffolded class spent more time on task, rather than waiting for feedback from their teacher. This may have been due to the fact that the procedures in the scaffolded class provided a pre-defined structure for students to follow while completing their study activities. This structure included opportunities for peer feedback and personal reflection on the quality of their work. The procedures students were to follow were provided in written form. This allowed students to know the next step and allowed the researcher opportunities to shift research responsibilities back to the students by having a tangible reference point available during discussions. Neither the students nor the teacher in the non-scaffolded class utilized this structure. Thus, these students needed much more hands-on guidance from the teacher.

Students from both classes sought out either the researcher or teacher for guidance during the activities. However, students in the non-Scaffolded class were more often waiting in line for their teacher's input, while students in the Scaffolded would frequently form groups to ask the researcher a common question. The classroom teacher assumed a high degree of control in his classroom. This contrasts with the role the researcher assumed for her class. She encouraged the students in her class to assume responsibility for the completion of their tasks, according to the methodology of the IPS. Consequently, engagement with the topic was higher for the scaffolded class. The increased level of engagement allowed students in the scaffolded class more time to create their initial article and to correct any mistakes or omissions in relation to the content of their articles. This supports prior research showing a correlation between time spent engaged in instructional tasks and increases in student achievement (Doyle, 1983; Montazemi & Wang, 1995; Van Dusen & Worthen, 1995).

The results in this study suggest that following the procedures of the IPS may have caused students to shift their mental focus from a procedural activity to an internal mental process (Bondy, 1984). Previous research on children's thinking processes has found that for some students the thinking process occurred without conscious direction on their part (McGregor, 1993). The students in the scaffolded class demonstrated that they were more aware of how their thinking affected the decisions they made. One student told the researcher, "I'm finished with the Information Seeking Strategies activity and will start my Use of Information activity tomorrow." Many students in the scaffolded class demonstrated this rudimentary identification of thought processes.

A second finding that is significant to educators is that the IPS might have an impact on student engagement with the topic. The benefits of increased engagement include increased time on task, opportunities for learning through repetitive exposure to material, readiness for higher-order thinking and opportunities for richer evaluation of student work (Newmann, 1992). By focusing the students' decision making on whether they are satisfied with the current situation and what they can do to change that situation, IPS strategies increase the opportunity for learners to become engaged.

Lastly, the IPS process did not increase anxiety levels for students in the scaffolded class. Students in both classes agreed with statements indicating generally positive feelings toward the study unit as a whole. Additionally, the classroom teacher liked the accountability the IPS scaffold provided for the students and the structure it provided to students. He stated that he would be willing to use it if he were to implement another unit of this type in his classroom.

When interpreting the results from this study, readers should consider that due to the unique population of participants and the following limitations the results presented are not generalizable beyond the current study. The teaching styles of the two adults in the classroom may have affected the results. The researcher acted as a participant in the study. As such, her biases and influences must be considered in light of the research question. The researcher did not have prior knowledge about the school performance of the students in the Scaffolded class. Therefore, her impressions of the students were based on what she observed during the implementation of the study. The classroom teacher had spent the entire school year with the students and had formed opinions about the students based on their performance over the previous six months. These differences in opinions concerning the students may have impacted the interactions between the teacher and researcher and the students in each class.

Implications

Prior research has found that one of the essential skills students must possess in order to be successful in problem-based learning activities is metacognition (Hill & Hannafin, 1997; Land & Hannafin, 1997). IPS models act as metacognitive scaffolds that support students while they become more adept at monitoring their own thought processes during the problem solving process. The structured vocabulary the IPS model provides allows teachers and students to label behaviors and clarify terminology, two activities that are recommended to enhance

metacognitive ability in students (Costa, 1984). Consequently, an unobservable process can be monitored and tracked through a set of prescribed steps and described using a standardized vocabulary.

In addition to shifting the focus of student metacognition from covert to overt, implementing the IPS model allows students to spend more time on task in a problem-solving situation. Increasing the time on task is likely to increase student achievement (Doyle, 1983; Montazemi & Wang, 1995). The IPS process provides a cognitive map for students to follow as they solve information-based problems. This map encourages students to assume ownership and responsibility for their problem-solving process. An added benefit of increased time on task is that students are exposed to the content involved with the problem situation more frequently. This may assist students in better comprehending the information relevant to their problem.

IPS models may provide overarching processes that students can employ in a variety of learning situations. The benefit of strengthened metacognitive skills is that students can then apply these skills to a variety of learning situations that may differ from the area in which the process was initially introduced (Bondy, 1984).

The results in this study provide support for a growing body of research suggesting that with appropriate support, students can succeed at complex, learner centered, research-oriented tasks (Brush & Saye, 2000; Eisenberg & Berkowitz, 1998; Hill & Hannafin, 1997; Land & Hannafin, 1997; Marchionini, 1989; Perzylo & Oliver, 1992). However, implementing a new process for completing activities in school might be difficult at first. Students may be uncomfortable with the accountability the IPS models place on them. By introducing the process in small steps and infusing IPS vocabulary throughout the school day, teachers can help students become more comfortable and skilled at implementing the metacognitive skills that are supported by this model.

Conclusion

Research suggests that implementing a process approach to research skills can be effective when certain conditions are met (Kuhlthau, 1993). These conditions include strong team-based planning and implementation activities, an emphasis on student engagement, and the presence of a collaborative learning environment. The current study suggests that a specific process, the Big Six Information Skills (Eisenberg & Berkowitz, 1988), might be effectively used as a metacognitive scaffold for students solving information-based problems.

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The Effects Of Collaborative Problem Solving On Individual Problem-Solving Ability

Yann-Shya Wu
Indiana University-Bloomington

Abstract

The purpose of this paper is to investigate how collaborative mathematical problem solving affects individual mathematical problem-solving ability. This paper begins with a review of the applicable theoretical notions on problem solving, and on collaboration as it relates to problem solving. Next it explains the experiment's method and procedures, and then goes on to analyze and discuss its results. Finally it presents some conclusions, along with a brief discussion of the project's implications for further research. The results show no quantitative differences between collaborative and individual problem solving. However, some qualitative differences were evident.

Introduction

"Problem solving" has been regarded and designated by many mathematics educators and researchers (see, for example, Goldin, 1982; Lester, 1982; Mayer, 1982; Schoenfeld, 1982, 1985) as an important activity in mathematics learning. Indicative of the perceived importance of this topic is its inclusion by the National Council of Teachers of Mathematics (NCTM) as a heading in its new standards for the mathematics curriculum, which list mathematics as problem solving along with mathematics as reasoning, mathematics as connection, an mathematics as communication (NCTM, 1989).

"Collaboration" too has been much advocated recently as a powerful factor both in learning in general and in problem solving in particular. This advocacy is based on social interaction frameworks (see, for example, L. S. Vygotsky, 1978), and is supported by the findings of research experiments (for example, Forman, 1981). These results confirm that for many types of problem solving the results of collaboration are superior to those of individual efforts. But how and why does collaboration function so effectively? More specifically, what are the mechanisms through which collaboration promotes problem-solving abilities? This has been the motivating question behind my research effort; and the purpose of this paper is to provide at least some partial, tentative answers.

In order to gain some answers, an experiment was designed and conducted that would enable the experimenter to observe both individual and collaborative problem-solving activities together, and to compare their results in terms of both quantitative and qualitative ethnographic perspectives. This paper will begin with a review of the applicable theoretical notions on problem solving, and on collaboration as it relates to problem solving. Next it will explain the experiment's method and procedures, and then go on to analyze and discuss its results. Finally it will present some conclusions, along with a brief discussion of the project's implications for further research.

Theoretical Background

It is not too overwhelming to say that the human civilization is a history of problem solving activities (Yang, 1994). Often in our daily lives we find ourselves working to solve problems in our lives, whether these problems are big or small, important or unimportant. We try to gain knowledge and skills both from school and in our daily lives in order to solve these problems. For example, we learn mathematics in order to solve those problems related to number, quantity, shapes, area, volume, and so on. And indeed, "mathematical problem solving" is both the main goal of mathematics learning (Brodinsky, 1977; LeBlance, 1977) and the most important activity of mathematics learning (Lester, 1980). In recent years advocacy from mathematics educators and researchers has resulted in increasing attention given to issues concerning mathematics problem solving and in the adoption of this activity as a major focus of a new set of standards for K-12 mathematics curriculum.

In traditional mathematical problem-solving activities in school settings, the most often used learning method is individual problem solving, rather than collaboration. Moreover, collaboration, often regarded as cheating, is commonly prohibited as a mathematical problem solving activity. Mason (1972) has the following impressive observation, "We isolate students by pitting them against each other competitively, and imposing on them a fierce decorum of silence and regimentation" (p. 6).

In view of the fact that collaboration has become a popular, effective, and efficient form of learning in daily life and in the work place, and has been advocated as a mode of working style to meet the rapid changes and big challenges of modern society (Senge, 1994), it seems reasonable to suppose that the mathematics curriculum should also increase its acceptance of collaborative-oriented problem solving in order to prepare the learners to collaborate with others in order to solve problems in daily life.

The significance of collaboration can be understood from two perspectives: first regarding it as a practical phenomenon, and then from the viewpoint of developmental psychology. In the following paragraph I shall consider each of these perspectives in more detail.

As a practical phenomenon, collaboration, or "working together", is in the very nature of society (Mason, 1972), and "inherent in everyday interaction" (Choi & Hannaffin, 1995, p. 62). As Forman and McPhail (1993) put it, "The everyday lives of adults are full of complex and ill-defined problems that require high-level reasoning and organizational skills. These problems are often solved in collaboration with other people. For example, a husband, wife, and babysitter may need to coordinate their weekly occupational and domestic work schedules in order to supervise one or more young children" (p. 213).

To acknowledge the fact that all human progress is a result of collaboration amounts not only to a simple affirmation that collaboration is the most common mode of social functioning (Resnick, 1987), but also to an indication of its status as the most magical of all human activities. In common-sense terms, progress is possible because "collectively, we can be more insightful, more intelligent than we can possibly be individually. The IQ of the team can, potentially, be much greater than the IQ of the individuals" (Senge, 1994, p. 239).

But how and why does collaboration function so universally, so effectually? The anthropologist Edwin Hutchin gives us an example that lets us begin to see how collaboration structures the efforts of a society, the formation of knowledge, and even the nature of cognition (in Resnick, 1987). In Hutchin's view, guiding a ship by triangulation on coastal landmarks entails both a complex interaction between helmsman and lookouts and a collaborative articulation of the fabric of knowledge itself, involving distance experts such as cartographers and gyrocompass-builders. Here we cannot speak of collaboration without saying something about the knowledge-structures involved, nor can we speak of the required knowledge without saying something about the collaborative processes through which it is put into effect.

When we look at the social deployment of knowledge, we find it inseparable from collaborative processes. That is to say, social learning-at any rate, social learning outside of school-takes place through collaboration. As Resnick (1987) remarks, "much activity outside school is socially shared. Work, personal life, and recreation take place within social systems, and each person's ability to function successfully depends on what others do and how several individuals' mental and physical performance mesh" (p. 41). Even if we choose to view learning as an individual process, we will find that it is collaboration that provides the "context in which supports for, constraints on, and challenges to an individual's thinking occur" (Forman & McPhail, 1993, p. 213). Yet there is reason to believe that knowledge is best measured as the collaborative achievement of a group. Barnes and Todd (1977), studying groups engaged solely in assigned talk, found that these groups attained cognitive levels higher than those attained by individual members. Under such a notion, knowledge is distributed in nature. To return to Resnick's analogy (1987) from Hutchin: "No individual in the system can pilot the ship alone. The knowledge necessary for successful piloting is distributed throughout the whole system" (p. 41). Resnick's conclusion is that most work and learning in a society is a matter of "shared cognition," not "individual cognition."

L. S. Vygotsky (1896-1934), from the perspective of developmental psychology, provided a conceptual framework to deal with this question through his analysis of the relationship between social interaction and higher mental processes. He felt that higher functions originate first in the social interactions, before they are integrated into the cognitive structure of the mind: "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological), and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relations between human individuals" (Vygotsky, 1978, p. 57).

Moreover, according to Vygotsky's view of development as a dialectical process, the individual cognitive structure of mind, having been internalized through interaction with the social environment, is then promoted to a state in which it will itself influence the social environment. So there is an ongoing reciprocal interaction, a bi-directional relationship, between the individual and the social environment. On the one side, the social environment or cultural frame within which the individual participates and interacts plays a crucial role in the development of human cognition; on the other side, the individual self is also an essential source in the social environment for fostering the ongoing reciprocal processes of interaction.

Vygotsky further proposed that any learning exploits a "zone of proximal development" or "ZPD." Vygotsky defined ZPD as "the distance between the actual developmental level as determined by independent

problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Vygotsky observed that children learning mathematics seemed to be using the ZPD they created for themselves in the course of collaborative problem-solving, in such a way as to attain higher levels of achievement than they would have been able to manage while working along (Yackel, Cobb, Wood, Wheatley, & Merkel, 1991). ZPD can be fostered by collaboration with adult or more competent peers, who supply a context "in which support for, constraints on, and challenges to an individual's thinking occur" (Forman & McPhail, 1993, p. 213). Within the resultant ZPD a group can attain cognitive levels not attained by individual members, leading the child on ahead in his or her development.

Purpose of the Research

The above section has explored the practical phenomenon of collaboration and some theoretical notions from developmental psychology about why collaboration works. These perspectives constitute the general background underlying the author's interest in investigating how collaboration might affect individual ability in mathematical problem solving. More specifically, what are the mechanisms through which collaboration promotes individual mathematical problem-solving abilities? To carry out this investigation a research experiment was designed in terms of the following questions:

- Is individual mathematical problem-solving ability after collaboration significantly different from individual mathematical problem-solving before collaboration? If so, what, quantitatively speaking, are the differences? And what, qualitatively speaking, are the important characteristics of these differences?
- Is collaborative mathematical problem-solving ability significantly different from individual mathematical problem-solving before collaboration? If so, what, quantitatively speaking, are the differences? And what, qualitatively speaking, are the important characteristics of these differences?
- Is collaborative mathematical problem-solving ability significantly different from individual mathematical problem-solving after collaboration? If so, what, quantitatively speaking, are the differences? And what, qualitatively speaking, are the important characteristics of these differences?

Method

A quantitative evaluation and a qualitative ethnographical investigation were conducted, focusing on four students in the same 4th grade mathematics class as they participated in two steps of individual problem-solving activities and one step of collaborative problem-solving activity.

Participants

The data-collection phase of the research was carried out using students from a 4th-grade class in an elementary school in Taipei, Taiwan, Republic of China. All these students were Chinese-Mandarin speakers. A group of four students out of a class of thirty-five was selected to participate in this study. This group of four students represented four different levels of achievement: high, median-high, median, and low. The selection method for this class was as follows:

A copy of the research proposal was sent to the school's research office, which in turn solicited teachers interested in letting their students to participate in the project. The class group selected for this study was one taught by one of the interested teachers who taught, initiated, and guided mathematics collaborative problem solving and discourse. Because the participants were members of a class group that was already familiar with collaborative problem solving and discourse, and also with non-synchronous thinking-aloud skills (Yang, 1994), an adaptation of thinking-aloud (Ericsson & Simon, 1985), the research project did not necessitate introducing the participants to any unfamiliar models of collaborative problem solving. No problems involving the establishment of a collaborative relationship were anticipated, because the participating students had practiced collaborative discourse and problem-solving since they were in the third grade.

The design of the selection of participants proposed by the researcher was: All of the students in the class were grouped into four ranks, based on their fourth-grade mathematics achievements level. One student from each rank was randomly selected by means of a random number table. Four students, representing a mixture of mathematics achievement levels, high, median-high, median, and low, were assigned to each group. The design of the selection of group size is consistent with the suggestions of the way of grouping in cooperative learning (which suggests small group size of 3-5 persons) (Johnson & Johnson, 1994), The design of forming group members is consistent with Vygotsky's ZPD notion which suggests heterogeneous grouping (Vygotksy, 1978).

In the research report, the participants' responses necessarily be described. However, no real names were be used. Rather, the participant with high level achievement was given by a letter "H," the participant with median

high level achievement was given by a letter "MH," the participant with median level achievement was given by a letter "M," and the participant with low level achievement was given by a letter "L".

Materials and Instrumentation

The purpose of the study is to investigate how collaboration might affect individual ability in mathematical problem solving. A vital preliminary to this project is to understand the context, Jen's Choice, where the participants of the research study were working with problem solving. Therefore, there is a need to introduce at the beginning of this section about Jen's Choice.

Jen's Choice

Jen's Choice is a Chinese-language computer-anchored 4th-grade mathematics instruction program, designed and developed by Dr. Hsin-Yih Shyu (1997) and associates at Tamkang University in Taiwan. Based on the notions of anchored instruction and situated cognition (CGTV, 1990), it provides an inquiry, and real life learning environment and authentic tasks for learner to solve mathematics and other cross-subject problems. The story describes that Jen, a fifth grader was accused by her classmates of stealing a watch from the class model student, because she showed her watch after the model student lost her watch. In order to find the giver of her watch, Jen's grandmother, to approve that the watch was really given by her grandmother, Jen, accompanied by her three friends, planned and took a trip to visit her grandmother. In order to do so, they had to encounter several plans and decisions, such as time planning, expense planning, among others, and these need them to apply 4th-grade mathematics and across-subject knowledge to solve problems and plans.

At the end of the story, two types of problems, one type is about life problem, the other is about mathematics problems, are provided to challenge the learner who view this program. In this research study, only mathematics problems are given to the participants to solve. The mathematics problems contain the following three mathematics problems:

Question #1: Up to now ("now" meaning before they buy tickets for the rides), how much money does each person have left?

Question #2: At the Children's Recreation Center, if everyone wants to ride the same rides, then how should they spend the remaining money on tickets? (Note that the cheapest ride at the recreation center costs three tickets.)

Question #3: Supposing that Jen's apartment is 15 minutes away from the Tamsui Station bus stop, and taking into consideration that she has to be home before 5:30 p.m., answer the following questions.

a) What is the longest possible time they can stay at the Children's Recreation Center?
b) What is the latest possible time they can leave the Children's Recreation Center? (supposing that it will take them 10 minutes to wait for a bus in front of the recreation center)
c) Which show can they see at Tomorrow's World Theater? 1:00 p.m., 2:00 p.m., or 4:00 p.m.

Because the nature of these three mathematics problems: authentic tasks, complex situations, real-life, therefore, it makes meaningful that Jen's Choice was used as instruments for test problem solving.

Procedures

The research experiment consisted of three steps. In step 1, participants, working individually on PC computer in a separated decent room, solved mathematics problems. First, each of the participants was shown ***Jen's Choice***. After that, three mathematics problems from this program were given to each individual participant to solve using paper and pencil. The participants were asked to show their mathematical problem-solving procedures, and also to engage in non-synchronous thinking aloud (Yang, 1994), an adaptation of thinking-aloud method (Ericsson & Simon, 1985) Thinking aloud is a research method that involves asking each participant in an experiment to speak out loudly, explaining as fully as possible, for every process he/she performs, how, why, and what he/she is thinking and doing. This is a vital method for investigating a participant's thinking processes. However, since the participant has to think aloud at the same time that he/she is doing a task, this procedure could interfere with the participant's thinking and acting. Therefore, the method of non-synchronous thinking aloud, was employed: participants were requested to 'think aloud', not while performing, but a little after completion of each segment of the task, in order not to interrupt the participant's thinking and doing the task. There was a facilitator with each of the participants to encourage non-synchronous thinking aloud and to remind the participants not to forget the non-synchronous thinking aloud.

In step 2 participants undertook group collaborative problem solving. One hour after the completion of step 1, the four participants were gathered together in a decent room having a PC computer, to solve, collaboratively, the same three problems they had solved individually in step 1. And as above, they were asked to engage in non-synchronous thinking aloud while, working as a group, they worked out their collaborative approaches to the problems with paper and pencil.

In step 3 participants again undertook individual problem solving, on a PC computer in a separated decent room. One hour after the completion of step 2, each of the four students was asked to solve, individually, the identical three problems again. All the procedures in step 3 were identical to those in step 1.

All three steps of the experiment were video recorded and audio taped. Cordless microphones were distributed to each participant to ensure that each participant's voice was clearly recorded and clearly heard by the others. These three groups of written solutions and video-recorded non-synchronous thinking-aloud protocols were compared and analyzed for quantitative and qualitative differences. Quantitative comparisons were made by evaluating the degree of correctness of the different final answers given to each of the three questions during each of the three steps. For qualitative comparison, these protocols were analyzed in terms of the following five components (Yang, 1994):

1. Problem perception, understanding and representation: evaluates the problem solver's understanding of what the problem is, and what the situation of the problem is; evaluates the problem solver's ability to draw a figure to introduce situational notation.
2. Mathematics knowledge and concepts: evaluates the participant's ability to access and apply the mathematical knowledge and concepts that are relevant to the problem.
3. Devising and carry out the plan: evaluates the problem solver's ability to devise a plan based on the problem, and to implement the plan step by step.
4. Consciousness and control of the plan: evaluates the problem solver's ability to consciously control what he/she is doing—to judge if it is meaningful or reasonable, and to adjust it when appropriate.
5. Looking back: evaluates the problem solver's ability to check the process of what he/she has done, identifying and correcting any mistakes or inappropriate solutions.

Results and Discussion

Figure 1 shows a summary of the total number of right answers for each of the three steps of problem solving.

Participant	H	MH	M	L
Step	Total no. of right answers		(Total no. of questions = 3)	
Step 1 (individual p-s)	0	0	0	0
Step 2 (collaborative p-s)	¼			
Step 3 (individual p-s)	0	0	0	0

Fig. 1. Number of right answers achieved by the participants in each of the three steps of the experiment

It seems that the results for collaborative problem solving were not significantly better than those for individual problem solving. Furthermore, collaborative problem-solving experience did not seem to facilitate later individual problem solving. But these conclusions, representing strictly quantitative results, are inherently limited in scope; they reveal nothing about the actual processes through which the participants constructed their understanding. At this point the learning process remains a 'black box.' An additional, qualitative, analysis is required in order to identify and evaluate the changes in thinking that took place over the three steps of problem-solving activity. Because the space limitations in this paper, the findings of this additional analysis are only briefly summarized here (Figures 2 to 5):

Participant: H									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	Step 3	step 1	Step 2	step 3	step 1	step 2	Step 3
Problem Perception...		x							
Math knowledge...	x	x	x	x	x	x	X	x	x
Devising... the plan		x							
Conscious... the plan		x			x			x	
Looking back...									

Fig. 2. Components of problem solving that participant H performs

Participant: MH									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	Step 3	step 1	step 2	step 3	step 1	step 2	Step 3
Problem Perception…		x							
Math knowledge…	x	x	x	x	x	x	x	x	x
Devising… the plan		x							
Conscious… the plan		x			x			x	
Looking back…									

Fig. 3. Components of problem solving that participant MH performs

Participant: M									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	step 3	step 1	step 2	step 3	step 1	step 2	Step 3
Problem Perception…		x							
Math knowledge…	x	x	x	x	x	x	x	x	x
Devising… The plan									
Conscious… The plan									
Looking back…									

Fig. 4. Components of problem solving that participant M performs

Participant: L									
Question #	#1			#2			#3		
Step/Compo.	step 1	Step 2	Step 3	step 1	step 2	step 3	step 1	step 2	Step 3
Problem Perception…									
Math knowledge…	x	x	x	x	x	x	x	x	x
Devising… The plan									
Conscious… The plan									
Looking back…									

Fig. 5. Components of problem solving that participant L performs

One of the reasons that all of the participants had very low achievement in solving the three problems was that they did not fully understand the problems when individually solving these problems. For example, when Question #1, "Up to now (meaning before they bought tickets for the rides), how much money does each person have left?" can serve as an example here. In the first step, the participants misunderstood it as meaning either 'how

much money did each of them have before they started the journey?' or 'how much total money did they, collectively, have left before paying for the rides?' Accordingly, they devised wrong plans, carried out wrong plans, and arrived at wrong things.

Doubtless the relatively high degree of complexity of the problems contributed to these frequent misunderstandings. Traditional educational approaches had accustomed the participants to less complex problems, for which all they needed was simply to put all of the numbers together without thinking too deeply. Thus, when they met with this experiment's much more complex problems, they were totally lost and confused, and tended to revert to just putting the numbers together. In such complex and challenging situations, collaboration does not seem to help, as can be seen in the results from the second and third problems. Even though the participants came to the experiment with considerable prior experience in collaborative problem solving and related mathematics knowledge and concepts needed for solving problems, collaboration at this time did not facilitate successful solutions.

Also, deficiencies in the categories of consciousness and looking back resulted most participants reaching wrong answers for almost all of the problems, even though they performed reasonable problem-solving procedures.

However, collaboration did facilitate control and monitoring of the collaborative problem-solving process. From the protocols, we were able to see that solutions and plans were revised due to the reminders from peer participants: when some peers were unable to find the errors, others, having found them, reminded those peers to be cautious and to rethink; the resultant back-and-forth arguments often resulted in reasonable solutions. This striking collaborative phenomenon may represent the most essential aspect of the collaborative function. As Forman (1981) said, "Both Vygotsky and Piaget would agree that social interaction provides the individual with feedback about his own thoughts and action which enables him to reflect upon and modify his behavior" (p. 2). Thus, The potential effectiveness of collaborative control in the problem-solving process is evident, for example, in the results from problem #1. Here, none of the participants were able, individually, before or after collaboration, to solve the problem correctly, or even to find the correct data to on which to do the calculation; but in collaboration, they were able to identify almost all the data needed to do the calculation.

Although the above findings do not support the conclusion that collaboration significantly promotes later individual problem-solving ability, the qualitative comparison data show that collaboration does have an effect on collaborative problem-solving strategies.

Conclusions

The aim of this research effort was to develop a deeper understanding of how collaboration affect individual mathematical problem-solving ability. In this research, we investigated how individual and collaborative mathematical problem solving took place in instructional contexts when anchored in authentic problem situations. The results of the research help us to see the different ways in which individual and collaborative problem solving approaches contributed to the participants' problem-solving strategies. These findings remain tentative, due to the participants' unfamiliarity with the style of the problem items (in particular, their high complexity), the small sample size, and the restricted components of observation. Further research designed to circumvent these limitations should achieve more complete and definitive results.

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Using a Lesson Template to Integrate General and Special Education: Teaching Lesson Template Use to Educators of Students with Special Needs

Francie R. Murry
G. Brandon Murry
University of Northern Colorado

During the last 50 years, the major tenets of most educational subjects areas have undergone little change; however, the characteristics of the student population and methods of teaching the concepts have evolved. The student population has been transformed by the differing ethnic, disabled, and cultural backgrounds that have entered the educational system. The methods of teaching have been impacted by the multimedia software and hardware.

The movement of including students with disabilities in the general education curriculum, specifically students with learning disabilities (LD), behavioral and/or emotional disorders (EBD), promoted by The Individuals with Disabilities Education Act (IDEA) has created a persistent challenge for the teachers who work with them. These students may have near average or above intellectual abilities, but disengage when in the general education setting for a variety of reasons (Kauffman, 2001; Koyangi & Gaines, 1993). The tight spot special educators find themselves in is how to connect these students to the curriculum, age-appropriate peers, and teachers while still ensuring effective learning.

Even though many of these students have the intellectual power, they cannot function in the general education curriculum due to skill deficits they show in performance. These perceived intellectual gaps complicate the connection between these students and their same-age peers because of the lower level of schoolwork they appear to be doing. If they are to remain in the inclusive setting these skills must be integrated with their daily learning of new skills. They attend programs where the emphasis is on behavior management and social adjustment ahead of academics and vocational preparation (Knitzer, Steinber, & Fleisch, 1990). They are underserved (Lewis, Chard, & Scott, 1994) and placed in more restrictive environments due to the availability of adequate public school education programs (Kauffman & Lloyd, 1992). Dodge and Coie (1990) found that the strength of the bond between students with special needs and their same-age peers resulted from how competent students with special needs felt at school. This competency also influenced the students with special needs level of self-concept, self-esteem, and self-identity. That is, it is necessary to develop lessons that engage this population and allow students to perform close to grade level for their affective as well as academic success.

The demand for educational accountability by policy makers and constituents increases the pressure for general education teachers who already have onus for teaching diverse populations of students. The additional responsibility of addressing state content standards and assessment while simultaneously addressing the affective needs of these students overshadows their ability to embrace a student with special needs into their classroom. Thus, special education must focus support in the modification and accommodation of the student's academic needs in order to free the general education teacher to address their affective needs and their social inclusion.

Teacher preparation programs have recognized their obligation to provide solutions for the dilemmas their teachers face once in the inclusive educational environment. The changing demands required by both general and special education teachers at the K-12 level are being addressed. One of these solutions is to provide access to technological innovations that help teachers meet the needs of a diverse population, complete the job quickly and efficiently, and have the ability to integrate best practices into the interface design and lesson content.

The study described here was designed to contribute to the field's knowledge of the use of technology to support modifications for students with LD and EBD in the general education curriculum. The process and outcomes of thirty teachers in a Special Education Master degree program using a template design system to modify lessons for students with learning, behavioral, and/or emotional disabilities in a general education curricular subject of science or language art was examined for efficiency, effectiveness, and appeal.

The researcher applied Gagne, Briggs, and Wager's (1992) condition of learning model to teaching the template use to the special education teachers. Gagne's five identified categories of learning are verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. The Kemp instructional system design (Kemp, 1997) identifies nine elements to step teachers through developing their modified lesson using the template. The Jerrold Kemp Design Model shown in Figure 1 takes a holistic approach by considering factors in the learning environment and includes learner characteristics, subject analysis, learning objectives, teaching activities, resources

(computers, books, etc.), support services and evaluation. Gagne's categories integrate nicely with the Kemp Design model. The entire process includes the best practice of teach, assess, teach, as well as being subject to continuous revision.

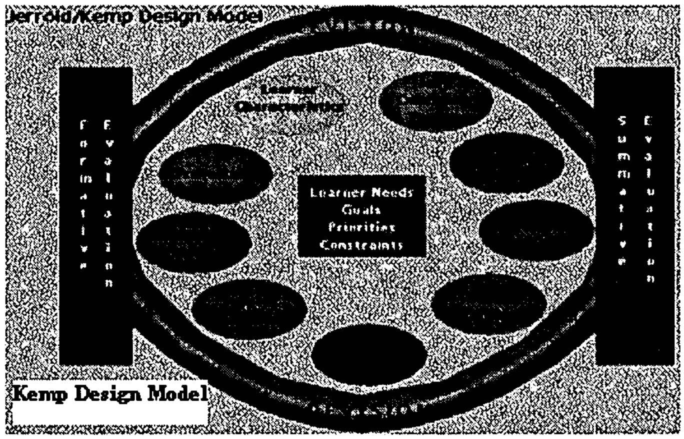


Figure 1. The Kemp ISD Model

Method

Participants

The participants in this study were 30 teachers pursuing a Masters degree for Colorado licensure in Special Education. Fifteen teachers taught in juvenile facilities and 15 taught in public schools. All 30 teachers taught at the secondary grade levels. Each of these teachers was responsible for teaching using the Colorado State Content Standards and preparing students to take the Colorado Student Assessment (CSAP). The students these teachers taught qualified for special education services in the primary categories of learning disabilities and emotional disturbances (designated in Colorado as Moderate Needs and Significantly Identifiable Emotional Disturbance (SIED), respectively). Eighteen of the master level teachers were earning general education licensure while simultaneously working under a state temporary teaching eligibility (TTE) for special education licensure. That is, 12 had a previously earned B.A. in Education while 18 did not have any previous teaching coursework and were on Emergency Teaching Licensure. In addition, all of the participants were earning the master degree in special education while teaching with a TTE. See Table 1 for details of the educational qualifications of participants.

Table 1. Teacher Education Qualifications

	Juvenile Facility Teachers (N=15)		Public School Teachers (N=15)
Teach Grades 8-10	7		0
Teach Grades 9-12	8		15
Earned B.A. in education	3	0 -- Special Education -- 1 2 – Elementary -- 5 1 -- Physical Education-- 1 Secondary (Science, 0 -- English, or Math) -- 2	9
Temporary Teaching Eligibility	15		15
Emergency Education Licensure	12		6

There were 6 males and 9 females employed in juvenile facilities and 2 males and 13 females employed in the public schools with an average age of 27 years and 31 years, respectively. See Table 2 for a participants' personal characteristics report regarding teachers' gender, age, and years of experience in teaching.

Table 2. Teacher Demographics

Juvenile Facility Teachers				Public School Teachers			
	Gender	Age	# of Years Teaching		Gender	Age	# of Years Teaching
1	M	24	1	1	M	23	1
2	M	26	1	2	M	26	1
3	M	28	2	3	F	26	3
4	M	30	2	4	F	26	1
5	M	33	4	5	F	29	4
6	M	35	6	6	F	30	6
7	F	25	2	7	F	30	5
8	F	26	1	8	F	26	1
9	F	27	1	9	F	26	1
10	F	29	1	10	F	27	3
11	F	31	1	11	F	28	3
12	F	31	2	12	F	29	2
13	F	31	2	13	F	30	6
14	F	32	3	14	F	32	12
15	F	35	10	15	F	32	10

Measures and Procedures

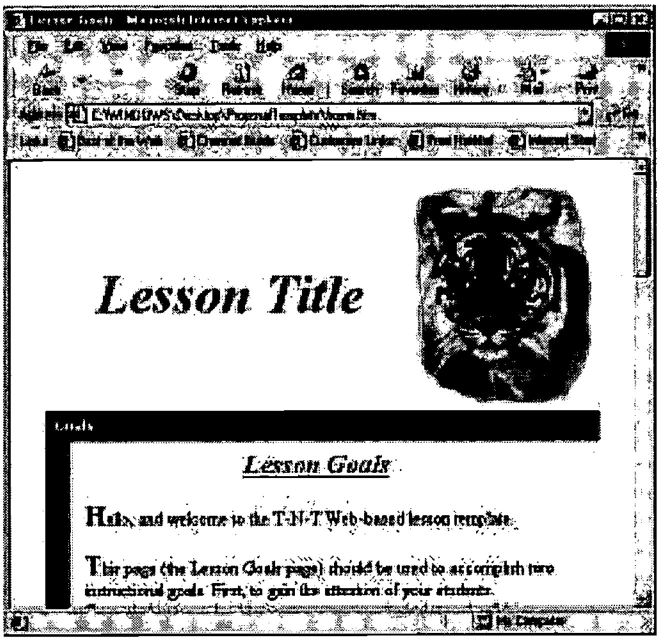
To begin the study each of the teachers were given two pre-instruments. The first assessed each teacher's level of technological sophistication and level of technophobia. Technological sophistication was measured by a researcher-developed questionnaire. The questionnaire solicited information on teachers' use of consumer technology (e.g., video-cassette recorder, automated banking, computer/video games, home care software), academic technology (e.g., word processing, programming use, library/research technology, classroom presentation packages/technology), and technology ownership. Technophobia was measured by level of computer anxiety. The Computer Anxiety Rating Scale (Form C) (CARS-C) (Rosen, Sears, & Weil, 1988) contains 20 items on a five-point scale that when scored derived a level of "no technophobia," "moderate technophobia." or "high technophobia."

The second evaluation tool examined the teachers' ability to develop lesson plans that included modifications/adaptations for students with specified characteristics of learning disabilities and emotional/behavioral disabilities. According to the Colorado State Department (CDE, 2000) special education teachers are to link state content standards to each student's IEP annual goals. Therefore, teachers were also required to include the state content standard they were addressing in their lesson plan. Teachers were in need of support that allowed flexibility. Thus, the dependent variables were (1) efficiency of the Web-based lesson template, (2) effectiveness of the template use on technical and instructional component inclusion in lesson plans, and (3) the appeal of the template use to special and general education teachers.

The training (independent variable) began with each participant being taught how to develop necessary modifications and/or adaptations to promote success of students with affective and academic disabilities on daily general education assignments and assessments. The areas of emphasis for modifications were lesson activities, required readings, and evaluations. In addition to teaching possible modifications, each teacher was taught how to write lesson goals that introduced the broad topic, learning objectives that included performance-based terms, action verbs, links to the goal, and were measurable and observable.

Each teacher was then instructed in the use of a web-editing program (Microsoft Front Page) and Teaching-Not-Teching (T-N-T) (Murry, 1998), a web-based lesson template. Each instruction period lasted 2 hours with ½ hour for questions and guided hands-on experimentation. T-N-T was designed to include each of the 7 components the teachers had been taught to use and include in a lesson plan for their students with special needs. The T-N-T template included navigation for goals, objectives, readings, activities, evaluation, glossary or chat room, and teacher e-mail link. See Figure 2 for a screen capture of the navigation found on each page of the T-N-T lesson template.

Figure 2. T-N-T Template Navigation



After selecting their topic area (Science or Language Arts) the teachers were provided time-log worksheets to track time that they spent thinking, tinkering, developing, and collecting items for their Web-based lesson. They were then instructed to begin the development of their first Web-based lesson using the steps listed below.

Step 1: Consider the learner characteristics;
Step 2: Matching characteristics to the instructional problem the lesson presented;
Step 3: Articulate what the student will accomplish in this lesson using performance-based terms;
Step 4: Write measurable goal(s) and objectives for the specific lesson using evidence from the students' Individualized Education Plan (IEP);
Step 5: Use the subject matter expert (SME) (e.g., the general education Science or Language Arts teacher) to provide ideas on materials, graphics, and other resources;
Step 6: Identify and determine which modifications and/or accommodations are necessary for success;
Step 7: Identify and collect the online readings and activities that relate back to the lesson goal(s) and objectives;
Step 8: Develop your lesson, planning the delivery and content outline;
Step 9: Develop evaluation instruction to conduct the assessment for your lesson;

Over the following 10-week period, the teachers developed 8 other Web-based lessons using Front Page and T-N-T for use with students needing parallel curriculum adaptation/modifications in the general education classroom.

A.

Results

The same battery of measurement instruments was administered to all 30 teachers before and after the training program. The performance of the teachers on the pretest and posttest measures is shown in Table 3. Mean group raw gain scores were observed on each of the lesson plan instructional and technical components (see columns 1 and 2). To determine whether the gains were educationally and statistically significant, the researchers subtracted the pretest score from the posttest score to yield a gain score. The mean gain on each component for the total sample is shown in column 3 of Table 3.

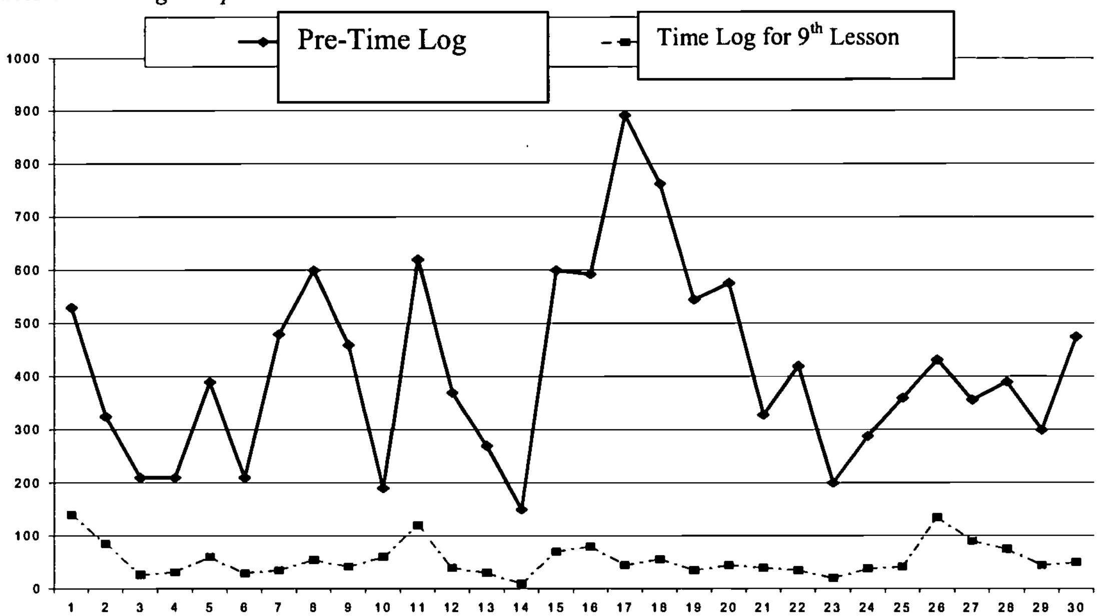
Table 3. Group Gain Scores on Dependent Variables

	Group Pretest Score	Group Posttest Score	Group Gain Score
Efficiency Lesson Development Time	347 minutes	56 minutes	291 minutes
Effectiveness			
Instructional (7 total)	2.1	6.4	4.3
Technical (3 total)	.5	2.9	2.4

Appeal			
Future Intended Use	15	27	12
Technophobia	25	8	17

The T-N-T template efficiency was defined as amount of time gained between the first Web-based lesson and the ninth lesson development. Teachers kept track of the minutes they spent thinking about content of the lesson, tinkering with Front Page and T-N-T, surfing the World Wide Web for graphics, collecting audio, video, and other resources. The average amount of time spent on the development of the first lesson was 347 minutes compared to 55 minutes on the ninth Web-based lesson. See Table 4 for a detailed comparison of each participant's development time between the first and ninth lesson.

Table 4. Time Log Comparison Between lessons



Effectiveness for the purpose of this study was defined as the inclusion and functionality of technical and instructional components in the Web-based lesson plans. The T-N-T lesson template navigation included each of the instructional components with the exception of a Content Standard link, thereby making it difficult for a teacher to ignore the need to include them. The technical components were also included in the template design; however, the lesson developer could alter the functionality. See Table 5 for pretest and posttest results of each participant's inclusion of instructional components and Table 6 for pretest and posttest results of functionality of the lesson technical components.

Table 5. Pre and Post Instructional Scores for Each Participant

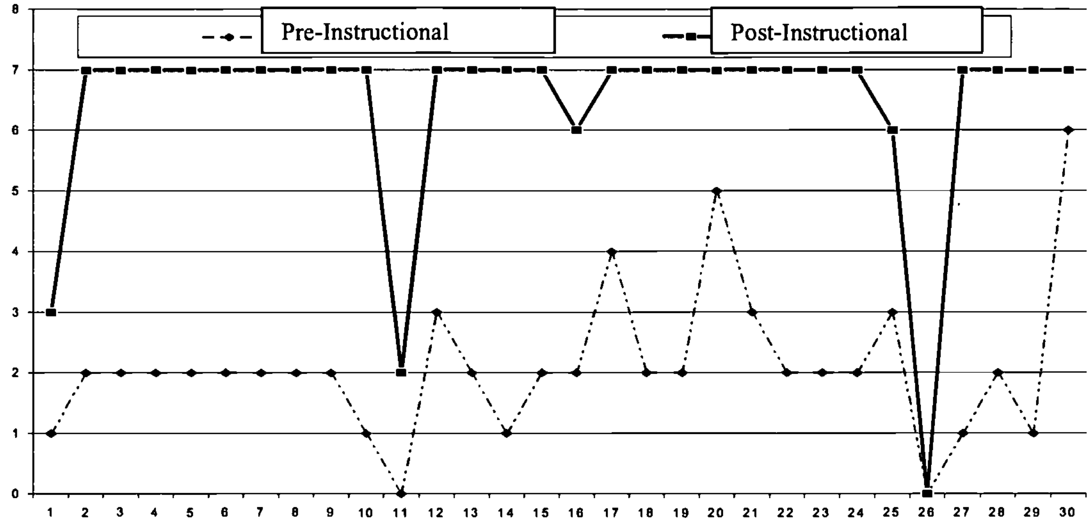
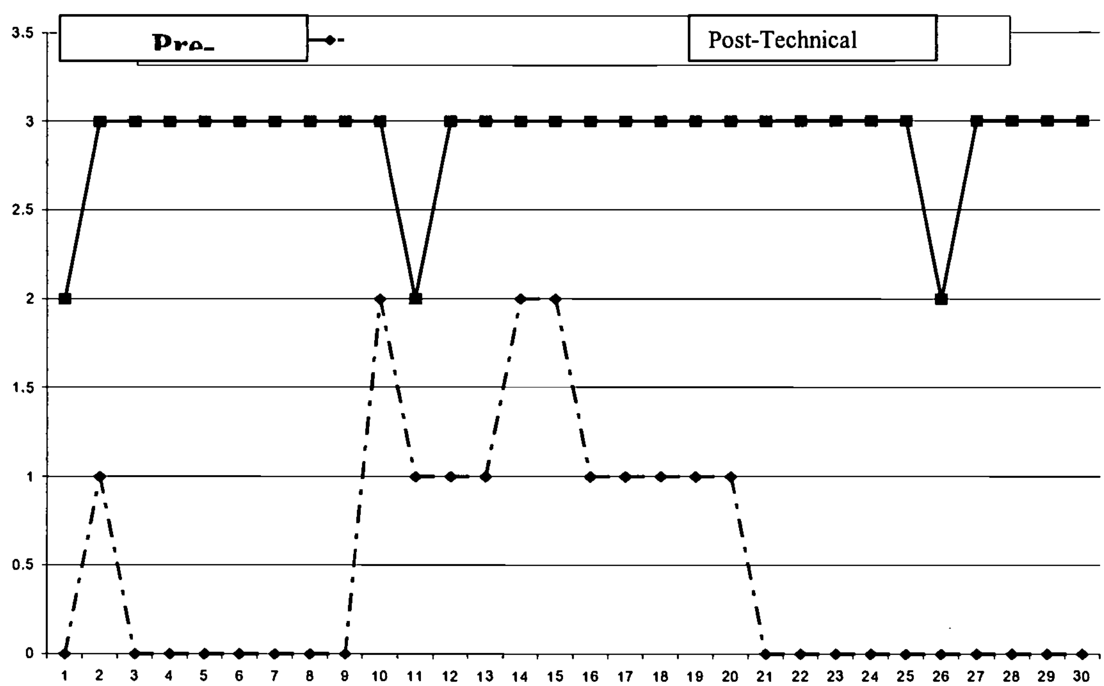


Table 6. Pre and Post Technical Scores for Each Participant



The dependent variable of appeal was characterized by the intended future use of the template by the special and general education teachers and by the change in pretest to posttest technophobia scores. The results of intended future use survey and the pretest posttest technophobia scores are reported in Tables 7 and 8, respectively.

Table 7. Pretest and Posttest use and Intended future use

	Pretest Yes N (%)	Posttest Yes N (%)
Use Web-based lesson template to adapt general education lessons for students with special needs	0 (0%)	27 (90 %)
Intend to expand the variety of technology used in my future teaching	2 (6 %)	27 (90 %)

Table 8. Pretest and Posttest Technophobia Scores

	Pretest N (%)	Posttest N (%)
High technophobia	6 (2%)	2 (.6 %)
Moderate technophobia	13 (4 %)	3 (1%)
No technophobia	11 (3.6%)	25 (8 %)

Discussion

Technophobia is a major concern in the educational arena. Technophobia has been categorized as the number one reason teachers fail to integrate technology in to the classroom. Utilization of the T-N-T template was investigated as a means to reduce technophobia to a manageable level and thereby allow teachers to integrate technology into the classroom in the form of Web-based instruction.

As a result of incorporating the use of T-N-T participant performance was substantially improved in several areas of concern. Technophobia was reduced in two categories (Moderate and High) with many students reporting moving into the No Technophobia category. Three students, who scored high in technophobia during the pre-test, showed little or no response whatever in the learning curve. The same students did not score well on the pre and post for template effectiveness, efficiency and appeal. This may have been due to attitude, age, or lack of motivation to use computer-based technologies. These students were the oldest in either of the groups.

Average lesson development time decreased from 347 minutes to 55minutes by the ninth lesson. The number of instructional strategies/components included in lessons developed by the participants increased dramatically. This increase is encouraging in that earlier teacher instructional behavior research has indicated that the discriminating factor between novice and expert teachers was that novices who did not start teaching with effective lesson development skills did not acquire them simply as a result of experience (Ayers, 1983; Housner & Griffey, 1994; Medley, 1980).

Functionality of the technical components included in the Web-based lessons developed by the participants went from 0 for many participants to the highest possible post-test score of three. The use of the template made this increase possible; however, the participants could have easily made the components nonfunctional. The fact that so many of the teachers succeeded with the template provides a solution to the findings of McCormack and Jones (1998). They found few educators possessed the required integrative ability to combine the technical knowledge and educational principles to construct effective Web-based educational environments. The template allows teachers to circumvent the necessary learning for technical technology skills while capitalizing on their emergent instructional skills.

Limitations

The researchers used the one-group pretest-posttest design in this experiment because the special education teachers were expected to provide modifications/adaptations of assignments for students in the general education classroom. The absence of a control group did not pose a serious threat to the internal validity of the experiment, however, because the researchers were able to safely assume that expected pretest-posttest gains due to extraneous factors would be minimal or nonexistent.

Conclusion

The use of a Web-based lesson template increased the potential for special education teachers to effectively support the inclusion of students with EBD and/or LD in the general education curriculum. As teachers become increasingly more efficient in Web-based lesson design they will transform education. The use of the T-N-T template will promote lessons that are derived from measurable student goals and objectives, activities that are linked to the goals and objectives, and quizzes that assess the stated learning to take place. The results of this study promote the thinking that teachers make selections based upon availability and immediate usefulness instead of applying the concepts or principles on teacher effectiveness (Guskey, Huberman, & Michael, 1995; Lortie, 1975) and will support the use of applications that enhance immediate usefulness and teacher effectiveness. It will also

encourage the use of technology for communication between teacher and students. The Office of Technology Assessment declared that technology was generally used in classrooms for low-level cognitive and instructional tasks (1995). This study refutes the very idea. "We have the potential to do great things with technology in our schools, but it is a potential still largely unrealized" (Riley, 1999, p. 9).

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Author and Keyword Index

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Editors
Maria Luisa Arias-Ferrero
Research Intern
And
Michael Simonson
Professor
Instructional Technology and Distance Education
Nova Southeastern University
Fischler Graduate School of Education and Human Services
North Miami Beach, FL

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Preface

For the twenty-third year, the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is sponsoring the publication of these Proceedings. Papers published in this volume were presented at the National AECT Convention in Denver, CO. A limited quantity of these Proceedings were printed and sold. It is also available on microfiche through the Educational Resources Clearinghouse (ERIC) system.

For the first time, these Proceedings are published in two volumes. This volume contains papers primarily dealing with instruction and training issues. Papers dealing primarily with research and development are contained in the companion volume, which also contains over 60 papers.

REFEREEING PROCESS: Papers selected for presentation at the AECT Convention and included in these Proceedings were subjected to a reviewing process. All references to authorship were removed from proposals before they were submitted to referees for review. Approximately fifty percent of the manuscripts submitted for consideration were selected for presentation at the convention and for publication in these Proceedings. The papers contained in this document represent some of the most current thinking in educational communications and technology.

M. R. Simonson
Editor

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COLLABORATIVE DESIGN AND IMPLEMENTATION OF A LARGE UNIVERSITY'S WEB-BASED COURSE

Chong Ho Yu
Angel-Jannasch-Pennell
Samuel A. DiGangi
Ruvi Wijesuriya
Arizona State University

Abstract

This paper discusses issues relating to the design, development, and delivery processes of multimedia modules such as Macromedia Flash®, Shockwave movies®, and Quicktime movies®. These modules were employed to teach an undergraduate plant biology class at a large southwest university. Each medium has different strengths and weaknesses. Their proper use resulted from the collaboration among the content experts, instructional designers, and multimedia developers.

Equipped with modern web technologies, instructional designers have abundant resources to deliver courses based in a multimedia and rich with interactivity. However, design is only one of several crucial factors of a successful web-based course. No matter how rich the media features are, obstacles during implementation hinder students from effective learning. For example, faculty without experience in multimedia development and distance education may under-estimate the required cost and resources, which may result in a delay of delivery and frustration. In addition, inexperienced Web developers might not realize the diversity of user computers. Web pages look good in a particular platform, a particular browser, and a particular setting might look different in other computers. Further, digital movie is said to be a useful illustration tool, however, lack of appropriate plug-ins and bandwidth may make the media unusable. VanHorn (2000) realized that bandwidth limitation would worsen the digital divide. Unfortunately, Web-based multimedia developers might not be aware of this limitation. In light of these potential obstacles, this paper discusses how a major university designed, developed and delivered a feature-rich web-based course for plant biology. It was found that in this case the design and delivery processes were more problematic than development. Solutions derived from our experience are suggested.

Course Objectives

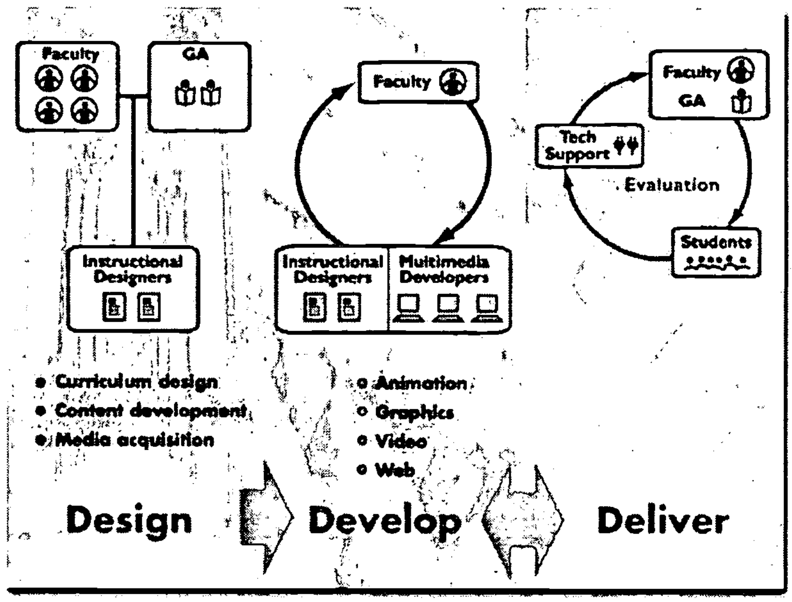
Plant biology 108 fulfills the Natural Science General Studies Course Requirements (S1 & S2). In keeping with the criteria of S1/S2 courses, the following are objectives for Concepts in Plant Biology

1. To provide a substantial introduction to the fundamental behavior of matter and energy as it relates to plants and to the plants' role in the biosphere.
2. To introduce the students to the scientific method and to have them gain experience with application of the scientific method to botanical problems. It is hoped that with such experiences the student will be able to use the concept of the scientific method for solving problems in everyday life.
3. To gain an appreciation and understanding of how plants work so that they may be manipulated to help solve such world problems as hunger, pollution, and global warming.

In order to fulfill the preceding objectives, use of multimedia animation were considered because several concepts in biology are process-based; it is more instructionally beneficial to illustrate those concepts in animation than plain text. The implementation of this multimedia web-based course was divided into three stages: Design, development, and delivery (see Figure 1). In the design stage, the focus centered around curriculum design, content development, and media acquisition. Instructors, including faculty and graduate assistants of plant biology, served as the content experts. Based on their input, instructional designers suggested the appropriate media. In the development stage, a positive feedback loop was established among faculty, instructional designers, and multimedia developers. Since the Web content could not updated easily, in the delivery stage a formative evaluation scheme was implemented. Students were encouraged to give comments and to report bugs to faculty, graduate assistants, and technical support

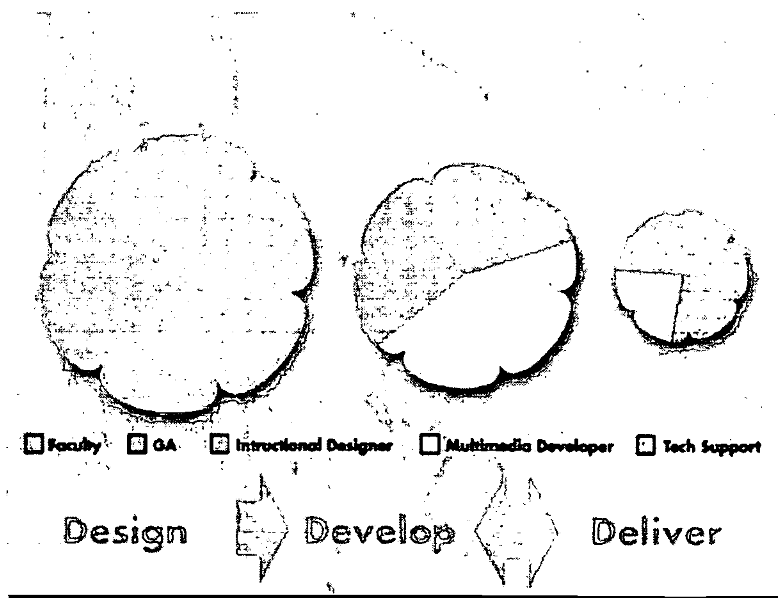
personnel. The feedback was re-directed to the instructional designers and multimedia developers for corrections and enhancements of the courseware. Each stage will be discussed in detail in the next section.

Figure 1. Stages of design, development, and delivery.



Allocation of both human and material resources is crucial to the development of a Web-based class. Besides specifying the task involved in each stage, the team also estimated the workload of each group in each stage (see Figure 2). This estimation set a reasonable expectation on each team member to ensure a smooth collaboration.

Figure 2. Resource allocation



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Design

PLB108 is a collaborative project between the Biology department and Instruction Support group. Faculty and graduate assistants in the Plant Biology department served as the content experts. Staff in Instruction Support served as instructional designers and multimedia developers (design team). The design team advised and assisted with course design, interface design, and storyboarding. The faculty worked closely with the Instructional designers to take ideas for concepts and convert them into a manner that best utilizes the multimedia delivery system. Based on the input from the content experts, the design team identified three media for serving different purposes, namely, MacroMedia Flash (MacroMedia, 2000a), Director shockwave (MacroMedia, 2000b), and QuickTime (Apple, Inc,.2000). Their capabilities, liabilities, and proper applications are described below:

Flash

Flash can use vector-based graphics and therefore its file size is much smaller. Unlike bitmapped graphics that are composed of pixels, vector-based graphics define the composition of an image by algorithms. A typical animated module made in Flash is as small as 10K.

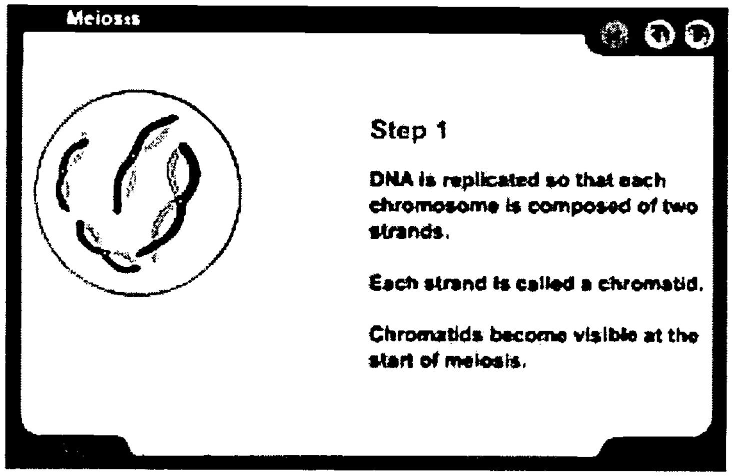
Another advantage of vector graphics is their scalability. Keeping the appearance of a Web page consistent is a challenge to Webmaster because monitor size, resolution, and browser size vary from computer to computer. Vector-based graphics answer this challenge. No matter what the monitor size and the resolution are, vector-based graphics are displayed at a pre-specified percentage, and they will resize themselves according to the browser size.

As mentioned before, consistency and bandwidth limitation are considered major hindrances from course delivery. Vector-based graphics are definitely one of the ideal media for the Web.

However, vector-based graphs carry less information than their bitmapped counterparts. Therefore, they are best-suited for drawing-based images rather than photo-realistic images. It doesn't mean that Flash cannot import pixel-based graphics for photo-realistic illustration, but including bitmapped images will definitely inflate the file size. Moreover, Flash lacks the interactive features and programming capabilities as that of Director.

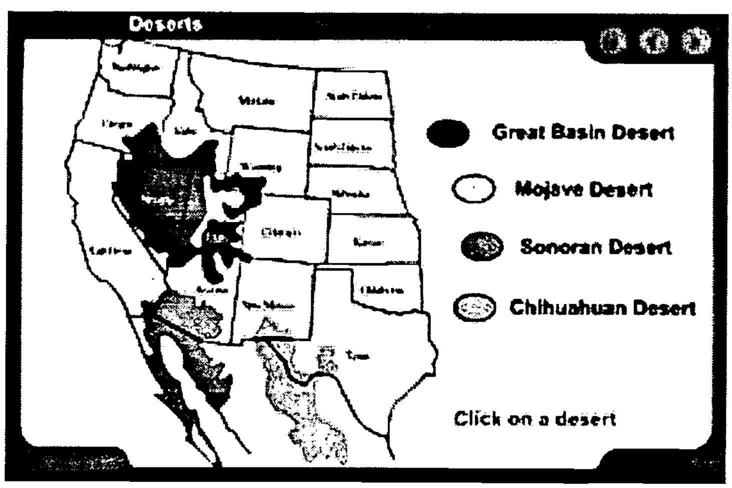
In the course, Flash is primarily used for modularized presentations. When a complex process is presented, a continuous and linear animation such as QuickTime may cause confusion among learners. An interactive step-animation is designed with the logical break-down of the process. For example, the Meiosis process was broken down into three steps. In each step, the animation is co-presented with descriptive text. The learner has the freedom to replay a particular step of animation (Figure 3).

Figure 3. Meiosis process presented in Flash



This approach is also useful to illustrate complex structure. In the Flash module displaying a flower structure, different components are showed in different steps, but the transition between steps overlay translucent components so that students understand how different parts of a flower are related to each other. In addition, Flash can also be used to associate geographical regions with biomes, which are worldwide groups of similar ecosystems that can be defined by their major vegetation type. In a Flash module, the user can click on several hot spots of a map to zoom in the region and photos of the region will be revealed (see Figure 4). Without an interactive module, the student may find it difficult to go back and forth between a map and photos.

Figure 4. Map of biomes



Shockwave

Shockwave is made by Macromedia Director, a multimedia authoring system with a powerful programming language, Lingo. Therefore, complicated modules such as highly interactive tutorials are better created in Director. Multimedia modules may involve a time-based process (e.g. growth of a plant, environmental change), a structural relationship (e.g. cell structure), or both. Every multimedia authoring package adopts some type of analogy, which is temporal or/and spatial oriented, to display the

programming environment. For example, HyperCard, HyperStudio (Knowledge Adventure, Inc., 2000), and SuperCard (IncWell, DMG, Inc., 2000), obviously, use a card analogy with an emphasis on spatial structure, in which different layers and objects represent different functions. Authorware (Macromedia, 2000c) uses a flow-chart analogy with a focus on temporal transition, in which icons "flow" along the decision tree. Director uses a movie frame and channel analogy. This programming environment incorporates both temporal (frame) and spatial (channel) dimensions. Therefore, it is considered more powerful than other authoring packages, which use either temporal only or spatial only metaphor. However, since graphics in Director are pixel-based and thus the final product, Shockwave, may be bandwidth-consuming.

In this course, shockwave is used for interactive tutorials that require user interactions. For example, in the illustration of natural selection, users are asked to drag a dark moth and a light moth to a light-colored tree. Later on, the same moths are dragged to a dark tree darkened by pollution. Before the pollution, the light moth is more likely to survive for its protective color in relation to the tree. After the pollution, the survival chances tip toward the dark moth (Figure 5). The objective of this exercise is to let learners see how environment affects natural selection. Although this concept can be illustrated by text, the camouflaging function of moth's color is more dramatic to learners when they actively move the moths from one background to another. This drag-and-drop approach is also used for testing purposes. For example, after students learned the lesson on herbaceous stem anatomy, they were asked to identify the internal organization of a stem by dragging the text into the right position. The exercise has a built-in correcting mechanism. If the student fails to drop the text into the right place, the text will revert to the original position and thus the student has to start it over until all components are correctly identified (see Figure 6).

Figure 5. The Peppered moth presented in Shockwave

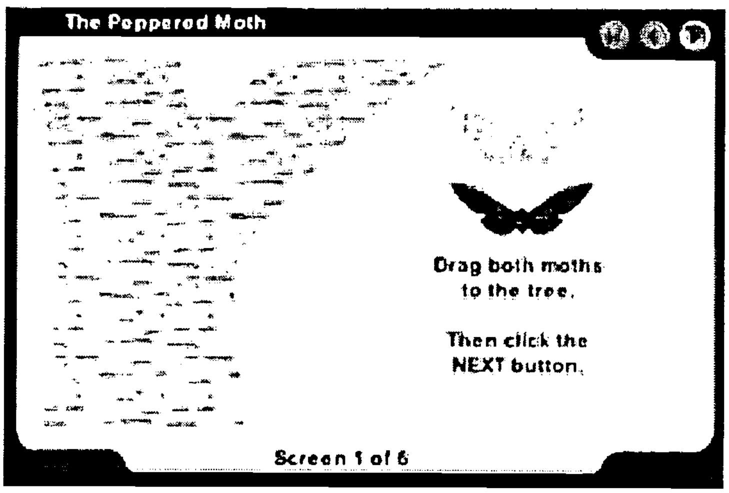
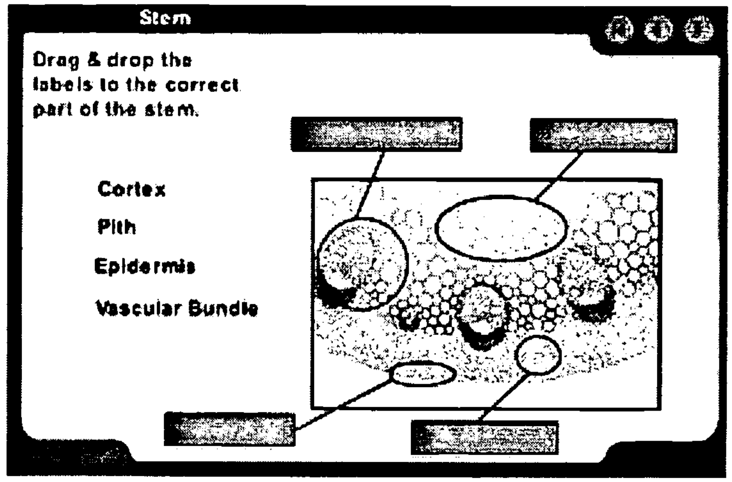


Figure 6. Stem anatomy exercise presented in Shockwave



QuickTime

The strength of QuickTime is its ability to show realistic movies within a low bandwidth because certain third-party software utilities such as Media Cleaner Pro (Terran, Inc., 2000) are able to compress QuickTime files without losing viewable quality. One of the drawbacks is that QuickTime does not have many interactive features. Among the three chosen media, QuickTime is the most bandwidth-intensive.

QuickTime is a proper medium for realistic movies. For example, many biology students may not have a chance to use a high-powered electronic microscope to observe objects at the molecular level such as how a new life is formed through the fertilization of an egg by a sperm, and how the movement of a cell (see Figure 7). This web-based course includes QuickTime movies, which were converted from footage taken from microscopes. In addition, QuickTime can be used for illustrating a time-lapsed process such as the growth of a plant. The purpose of this QuickTime illustration is to explain that each organism has a finite size that it can achieve (see Figure 8).

Figure 7. Movement of a cell showed in QuickTime

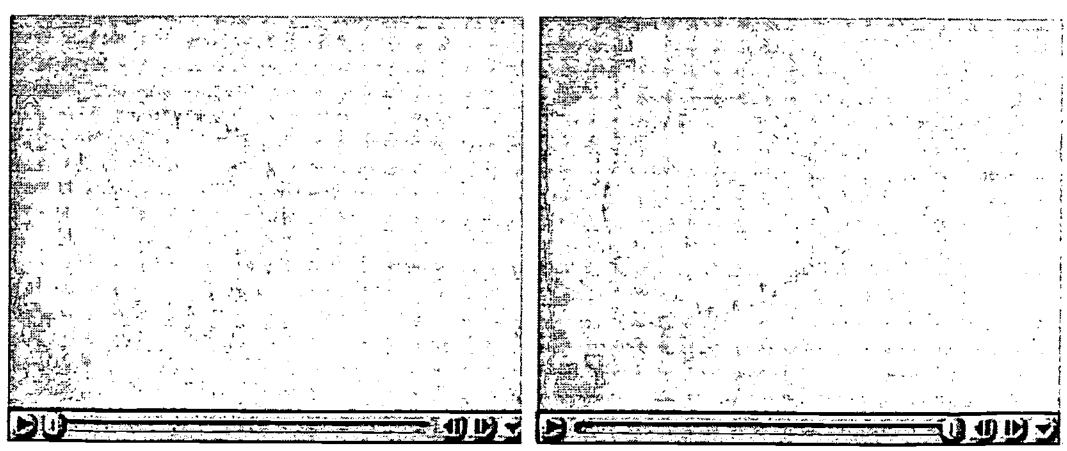
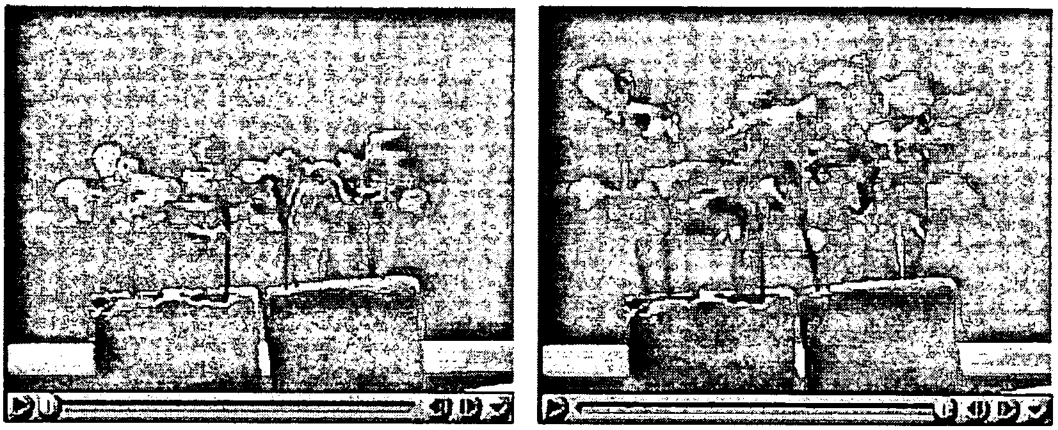


Figure 8. A growth process illustrated in QuickTime



Another use of digital video is the re-creation of historical events. Reading text about history may be dry, however, dramatization of history by actors and actresses gain students' attention. In this class, Mendel and Darwin, prominent figures in biology, come alive in digital video interview.

Software and hardware requirements were imposed on registered students. All the preceding multimedia modules were designed to run on the combination of these specific software and hardware configurations. The minimum requirements are:

- Windows 95/98/NT or Mac OS 7.5
- Multimedia Pentium or PowerPC
- 28.8 modem
- 800X600 resolution, 256 colors (8-bit)
- Netscape 4.0 or Internet Explorer 4.0 or AOL 4.0
- QuickTime Player 3.0
- Shockwave/Flash Player 7.2

The design team was aware that students might not have QuickTime or/and Shockwave/Flash plug-ins. Technical assistance to students will be discussed in the section of delivery.

Development

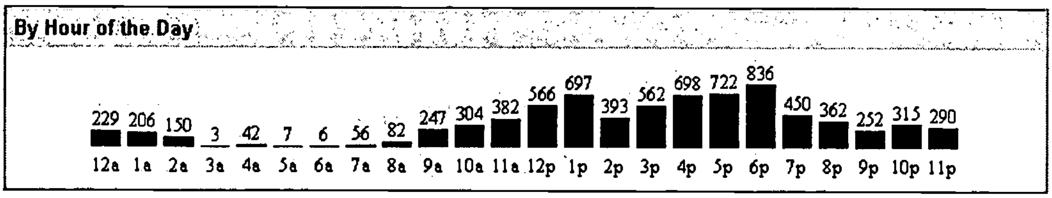
At the development stage, instructional designers worked with multimedia developers to convert the storyboards into multimedia and upload the course to the web. With each release, the faculty proofread the media and provided feedback and changes if necessary. To simulate a realistic learning environment for beta-testing, testers accessed the web content through a dial-up modem and viewed them in a 15-inch monitor. It was found that download time of QuickTime movies was excessive. To counteract this problem, QuickTime movies were burned into a compact disc and offered to students as an alternative. To increase the user-friendliness of the CD, a front end written in MacroMedia Director was inserted so that users could easily navigate across movies. Taking bandwidth into consideration, the development team had decided to convert QuickTime movies to QuickTime streaming and Real streaming movies in the next release. The difference between a digital movie and a digital streaming movie is that the latter can play almost immediately while more signals are being "streamed" to the destination.

The copyright issue was a major concern during the development process. Besides using royalty-free images, the development team created many drawings and diagrams. Approximately half of the development time was spent in creating original artwork for the course.

Delivery

The course was delivered through Blackboard's Courselnfo, which has built-in features for Web-based courses such as login, quizzes, grade book, chat room, bulletin board, user access tracking, and many others. Students were required to log in, and their movement within the course website could be tracked. Tracking website traffic enables the network administrators and WebMasters to identify the "rush hours" and thus to choose a better time for updating webpages. For example, the user log (see Figure 9) clearly indicates that during lunar hours and in the evening (5-6 p.m.) the server received most hits from users.

Figure 9. Usage of Website by hour of the day



Despite that hardware and software requirements were specified prior to the course, several students were not able to fully access the course materials due to the absence of a proper Web browser and plug-ins. This was anticipated and a technical support team had stood by to provide assistance in upgrading the browser and installing plug-ins. The technical support service was accessible by both email and telephone.

Summary

Initially, the design process and development process were labor-intensive. It is important to structure the materials during the design process so that later modifications are minimal for future courses. Moreover, when the course is well-structured with rich content and media, based on the input from experienced faculty, a graduate teaching assistant is able to deliver the course seamlessly. As a result, experienced faculty can be released from teaching introductory classes and hence concentrate on research and teaching of upper division courses.

Examples of multimedia resources mentioned in this article are available at http://is.asu.edu/plb108. Readers are encouraged to explore the posted modules and give us feedback.

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LEARNING SYSTEM DESIGN CONSIDERATIONS IN CREATING AN ONLINE LEARNING ENVIRONMENT

Scott Schaffer
Florida State University

Introduction

This paper describes the design of a web-based learning environment for leadership facilitators in a U.S. military organization. The overall aim of this project was to design a prototype of an online learning environment that supports leadership facilitators' knowledge development in the content area of motivation. This learning environment was designed to provide new learning opportunities for facilitators to build content knowledge through interactive learning activities and experiences with other members of their own community. In order for this learning and performance environment to continually improve and be effective in the long run, issues concerning diffusion of the technology and ongoing learning community development should be addressed.

The iterative design phases used to develop this web-based application are illustrated in Figure 1 below. The processes of analysis, design, and evaluation are often thought of as unique, stand-alone events. This project was managed as a concurrent solution design process incorporating elements of strategic thinking, change creation, work environment design, and rapid prototyping. The front-end analysis and impact evaluation were built into the design process.

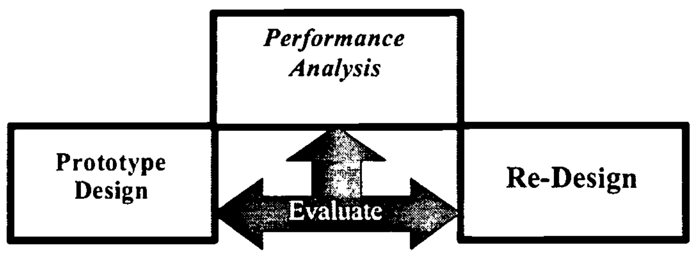

Figure 1. Iterative Design Phases

The use of this iterative solution design process allowed for increased efficiency and effectiveness in making ongoing refinements and improvements to the prototype. The designers utilized the learning environment design principles identified in the next section to drive the major tasks and to assure project quality.

Additionally, actions considered necessary for ongoing support of the web-based environment were summarized in two major areas: 1) Diffusion of the technology into the facilitator community, and 2) Continuous improvement and adaptation of the site by the community.

Key learning environment design principles and concepts

The project team agreed upon three broad areas of learning environment design. These components address a wide array of solution analysis, design, development, implementation, evaluation and diffusion issues. For the sake of brevity, these principles have been listed, but not fully elaborated upon, below. These principles are useful as guides to match project needs with learning environment features.

Analyzing

- Identify people who are accountable for the results of learners and engage them in the design goal setting process.
- Identify components and levels of the organizational system where performance-based results are dependent on learning achievement.
- Determine measures of success of learning and performance on an individual and organizational basis.
- Plan how you will evaluate this success (pre-post learning).
- Identify non-training, work environment factors that could contribute to the success or failure of the web-based learning environment.
- Create a plan for diffusion and adaptation of the learning environment within the organization.
- Create an awareness and knowledge of the analysis process.

Designing

- Create learning objectives from performance objectives, based on task, job and/or performance analyses.
- Create activities that gain the learners' attention by engaging them in the learning process.
- Create activities that show learners how the instruction will be of benefit to them.
- Provide ways for the learners to practice learning activities and get feedback on their performance.
- Create ways for learners to assess their own performance in a meaningful way that simulates the actual performance as close as possible.
- Create ways for learners to access a common knowledge base of resources on a given topic.
- Provide ways for learners to interact with instructors and with other learners.
- Provide ways for learners to gain multiple perspectives on a particular problem solving approach.
- Provide a means for learners to access knowledge based on previous learners' experiences.
- Engage members of the learning community or organization in adaptation of the learning environment for better fit within the current culture.

Continuously Improving

- Collect data to measure the success of learners and specific learning environment design processes.
- Identify non-training, work environment factors that could contribute to the success or failure of the web-based learning environment.
- Adapt learning design processes / adapt environment to optimize performance of learners.
- Collect data to measure the success of performers and the organization in meeting goals as related to learning activities and objectives.

These key design principles were used as the foundation for a pre-prototype evaluation plan. The plan included questions derived from a variety of performance improvement theories and models. A solution design decision aid assisted in evaluating the effectiveness of the learning and performance environment. Tables 1 through 5 are excerpts of this decision aid.

Table 1: Strategic Organizational Context (adapted from Ely; Kaufman; Rogers) Evaluation Probes
Strategic Linkages
▪ How are project objectives linked to the job, work center, and organizational missions and vision?
▪ Has a continuous improvement plan including impact evaluation been completed for this project?
Innovation-Change Adoption
▪ Is there a primary stakeholder, and owner of this project that will support its adoption and diffusion?
▪ What are barriers that may prevent long-term or continued success of the project?

Table 2: Organization-Work Center Context (adapted from Gilbert; Wedman & Graham) Evaluation Probes
Expectations and Feedback
▪ Do performers know what is expected of them on the job? Do they know when they have done the job correctly?
Tools and Information
▪ Will supporting documentation, job aids, and other performance support be available?
▪ Is there time in the work schedule for performers to use new skills learned in training? (TT)
Rewards and Incentives
▪ Is completion of tasks rewarded or punished?

Table 3: Performer Context (adapted from Keller; Wedman & Graham) Evaluation Probes
Motivation and Self- Concept
▪ Do workers want to do good work?
▪ Do they monitor their own performance?
Performance Capacity
▪ Are workers physically able to complete job tasks?
▪ What degree of flexibility with respect to work pace, structure, and organization is required of workers?
Skills and Knowledge
▪ Do workers have adequate knowledge and skills to do the job well?
▪ Which skills taught in training are not being used on the job? Why aren't they being used? (TT)

Table 4: Instructional Design (adapted from Dick and Carey; Keller) Evaluation Probes
Practice/Assessment:
▪ Does practice seem relevant to on-the-job expectations and performances?
▪ Do practice items/assessments match objectives?
Feedback:
▪ Does feedback promote learner satisfaction with the learning experience?
▪ Does feedback encourage further exploration? How could exploration be further encouraged?
Interactivity:
▪ If appropriate to objectives, is interaction among learners supported?

Table 5: User-Computer Interface (adapted from Nielsen) Evaluation Probes
Visibility of system status
• Does the learner know where he/she can/should go next?
Match between system and the real world
• Does the online learning environment represent or support the work environment?
Consistency and standards
• Is there a standard convention used to identify key areas of the site?
Aesthetic and minimalist
• Is information presented progressively from more general to more specific, thus allowing learners to drill down to in-depth information as necessary?

To accomplish the objectives of this particular project, the iterative design phases (performance analysis, prototype design, and prototype re-design) were integrated with the design principles to produce a functional prototype. A review of this integration process and recommendations for implementation of the prototype follow.

Performance Analysis

Performance analysis was a process of defining the results expected by the leadership community and the facilitator practices that could lead to achievement of those results. Current and desired facilitator results, practices, and attitudes were analyzed during this phase. Measurable results, critical performance and learning measures, achievable facilitator practices, and work environment factors and conditions that support or hinder performance were profiled. Prototype design began after performance objectives and the flow of information in the leadership facilitator community were identified. The results of analysis were used to guide the planning for the evaluation, design and implementation of the learning and performance environment solution.

Prototype Design and Re-design (Continuous Improvement)

Participatory design processes are effective in building stakeholder and user commitment to the success of application systems through their active participation in the analysis of requirements and the specification of the system design. For this project, each design iteration and improvement was based on discussions with key sponsors, stakeholders and potential users. Participants and designers collaborated to develop a potentially valuable product, identify possible product improvements, and generally provide one another with guidance in the ongoing design of the product.

During this concurrent design and evaluation process, interviews and focus groups were conducted during which visual prototypes clarified concepts that were being discussed. Initial prototypes were PowerPoint slides, which were transformed into a prototype web site using simple WYSIWYG web design tools. To assist in this transformation, members of the target audience provided initial feedback regarding the site look and feel, and overall concept. Following initial feedback, a "joint application design" meeting was held with sponsors (designers, project managers, directors) during which the first relatively primitive web-based site was reviewed live. The purpose of this meeting was to collect data to assist in design decision-making. This review followed a somewhat orderly process with a set of structured interview questions accompanying the review of each screen. A major goal of this design iteration was to ensure that the organizational learning and performance objectives of the site were addressed.

Following this meeting, revisions were made accordingly in order to prepare the site for usability testing / evaluation. The evaluation process included, but was not limited to, assessment of the aesthetic

quality of the interface, and following redesign, assessment of the content, learning activities, and achievement of objectives.

The first level of evaluation was with facilitators at a large training unit with more than 100 facilitators. Upon familiarizing the facilitators with the basic goals of the site, they were provided the URL and asked to provide feedback (we have been requested to not release the results of these evaluation processes by the client).

Following this process, the evaluation processes listed below were also completed:

- Learner/Performer Evaluation - A survey was placed on the website to gather input from facilitators regarding their reactions to site content and learning activities, and suggestions for improvement. Users also had the opportunity to provide feedback on the site discussion board.

- Individual interviews with novice users were conducted to observe a typical user interaction and resolve any barriers to navigation and learning. The user went through each activity and made suggestions for the content and layout of the site.

Specific strategies and recommendations related to utilization and ongoing support of the prototype that was designed and delivered to the client were proposed. These strategies and recommendations were focused in two key areas: 1) Adopting and diffusing the product within the target organization; and 2) Continuously improving the design and usefulness of the current prototype once it has been adopted by the target organization.

Adopting and Diffusing the Product: Implementation Strategies

The most well designed products often go unused or unappreciated within organizations often due to the lack of sponsorship and inadequate attention to the diffusion of the new technology. During the performance analysis phase of this project, many non-training, work environment factors that could contribute to the success or failure of the web-based learning environment were identified. Critical diffusion and work environment factors are identified below to highlight some of the biggest challenges to project success with this particular target audience. Recommendations relative to these factors have also been included.

Redefining/Restructuring, and Clarifying Relationships/Roles

These two critical stages in the diffusion of a technology within an organization have been documented by researchers in many different organizational settings (Rogers, 1995). Following initial design, development and evaluation of the web-based learning environment, it was expected that members of the facilitator community will begin the process of redefining/restructuring and clarifying roles related to this technology. Also see *Communities of Practice* by Wenger (1998).

The following recommendations were put forth in an effort to assist in the initial adoption, and redefining/clarifying of the prototype. Long-term evaluation of the site is possible only after adoption and utilization of the prototype by members of the facilitator community.

Recommendations:

- Identify decision-makers that will advocate the site. This is the identification of key stakeholders within the facilitator community who take responsibility for the product. The project sponsor and individual training units will be responsible for identifying key adopters, change agents, and problem-solvers who will champion the use of this innovation by members of the facilitator community. These role players will be active participants in the design, re-design, and evaluation of the application.

- Identify implementation managers who will diffuse the site throughout the facilitator community. This is a critical aspect of the early design and development of any new product. These are early adopters that must assume the burden of "selling" the product to others, as well as taking on much of the responsibility for its success. One strategy that stakeholders may use is to integrate this tool with other performance support tools currently in use.

- Introduce the site during ongoing activities already existing in the environment.
  - Introduce the site during initial mentoring,
  - Have trainers and mentors introduce the site as a tool for individual and job development The site could help experienced facilitators mentor and coach less experienced facilitators. Facilitators may be positively influenced to use the site if it is encouraged by their mentors as a useful way to develop skills and build new knowledge.
  - Introduce the site as part of facilitator training. Introducing the site as a tool that can be used by facilitators to build knowledge and skills related to job duties and responsibilities will increase its potential impact and overall effectiveness.

Resources for ongoing design and development

Identification of adequate resources, human and financial, to support the maintenance and continued growth of the application is crucial to success. This is an often-neglected aspect of computer-based application development, especially if the technology requires frequent updating. Web-based technologies are easier to update than other technologies and thus represent a potential long term cost savings.

Recommendations:

- Form a team responsible for learning and redefining the website. Although time and monetary requirements are minimal, it will be essential to identify key personnel who will be responsible for supporting ongoing maintenance of the site. It was suggested that internal facilitators who are familiar with the facilitator community and current practices be trained in change and redesign processes. A technical support resource responsible for updating and refining software and hardware will also be required for continual improvement of the site.

- Conduct prototype review groups with potential users and opinion leaders. Continual feedback from the learning community is helpful in redefining and redesigning the site to support and build on current course content.

Incentives

Incentives and reward systems are one of the least understood yet most effective methods of improving performance in the workplace. The benefits of participating in the learning environment include improved performance, self-development, and professional growth.

Recommendations:

- Official "release" time for participation in learning activities, and recognition for participation are highly recommended. The costs of release time can be considerable but the potential benefits of participation, in terms of improved performance, are well worth the cost.

- Facilitators should receive positive consequences and encouragement from their command to use the site as part of their ongoing skill development.

Process Management

Technical and human resource management will be required to ensure consistent, supportive, and performance-oriented system implementation. The interrelationship of this new process with other facilitator processes is part of the role of project leaders.

Recommendations:

- Leaders of this project within the facilitator community must be fully engaged in the process of creating, refining, communicating and using knowledge that is supported by technology.

- Periodic feedback should be elicited from facilitators to continually improve and add areas of interest to facilitators that are actually using the site.

Equipment (see *Site Technical Maintenance* section)

Hardware and software, physical information infrastructure, and documentation will be required to support initial and ongoing system development.

Recommendations:

- Current computer hardware and software must meet minimum specifications in order to capitalize on emerging technologies. This is probably the most expensive (monetarily) of all implementation factors, but can pay off in learning and performance effectiveness in the long term.

Continuous Improvement of the Learning and Performance Environment

The following section lists the major components of the web-mediated learning and performance environment. These components address the learning objectives required to achieve selected facilitator performance requirements or best practices. By addressing the best practices that were identified through the performance analysis, this learning environment has a greater likelihood of having a positive impact on facilitator, performer, and organization readiness. The pages that follow offer a brief description of each component of the learning and performance environment, and recommendations for continuous improvement and maintenance of each component on the website. Many of the recommendations included here were generated during the participatory design processes.

Learning Environment Component: Practice

Purpose: To enhance content knowledge and problem solving ability in the area of motivation through a variety of Self-Assessment/ Content Mastery activities.

These activities include multiple choice, matching and "essay"/case study response formats in an effort to enhance situational problem- solving ability.

Recommendations for Ongoing Development:

- Monitor and update self-assessment items to reflect current course content.
- Continually develop new items that challenge users and reflect current research and practice in the area of motivation.
- Ensure relevant, corrective feedback for each item.
- Add tutorials that provide a review of classroom material for each level of the course guides for motivation.
- Identify current problems to which facilitators can apply basic problem solving skills to solve larger issues/concerns.
- Monitor case study submissions to ensure learning opportunities go beyond that presented in the classroom.
- Continually add new case studies. 'Expert' facilitators could be identified to update and maintain relevant case studies.
- Review submissions by peers and revise as necessary.
- Revise case studies as field experiences change or as current case studies become outdated.
- Hold expert forums in the chat room and/ or archive interview transcripts.

Learning Environment Component: Discussion Board

Purpose: To provide current learners with a platform to build usable knowledge for current and future facilitators and leaders through interaction.

Features include: Message Board with chat feature to share ideas, experiences, discussions, etc., and Synchronous and Asynchronous communication options.

Recommendations for Ongoing Development:

Cleaning up/Monitoring

- Continually monitor information for accuracy.
- Delete outdated or incorrect information.
- Review other discussion boards that may better suit user requirements (see *Site Technical Maintenance* section).

Maintaining Interactions

- Periodically post new discussion topics.
- Encourage participation by "graduates" now on the job.
- Provide positive consequences for facilitators to interact with others on the discussion board.
- Reward expert facilitators or SME's who participate in scheduled discussions.

Learning Environment Component: Help

Purpose: To provide assistance and reduce frustration in navigating through the site. Features include a Site Map, Technical Help with FAQ's and site tips.

Recommendations for Ongoing Development:

Updating/Revising

- As facilitators become more familiar with the site, Help section will require frequent review/revision.
- Monitor and delete/update FAQ's. Facilitators should be encouraged to ask questions of their peers and to respond to questions appropriately.
- Revise site map/navigational tips based on revisions and advancements to the site.

Learning Environment Component: Knowledge Base

Purpose: Where all other features converge to allow for storage of objective (known facts, theories, procedures) knowledge and to promote constructed (new) knowledge.

Features include: Library with motivation-related readings, instructional resources, and links to other organization web sites.

Recommendations for Ongoing Development:

- *Monitor and update/delete "dead links" to remain current. Many online resources are deleted by the site authors after a certain period of time and therefore many links may become "dead" links.*
- *Links should reflect current course content and should not present views conflicting with current curriculum.*
- *Expert contributions should be archived and continuously updated.*
- *Archived models/theories should be created and easily accessed.*
- *A drop-down menu can be created so that reactions to information found in web links can be accessed under each link in the Library.*

Learning Environment Component: Evaluation

Purpose: To provide an opportunity for the user to aid in the continual development of the site.

Users complete a profile that identifies them by location and level experience, among other factors, and solicits their feedback on the site. This profile is also suitable as a Level One (Kirkpatrick) reaction evaluation tool.

Recommendations for Ongoing Development:

- *Evaluation responses should be logged and continuously monitored to assist in usefulness of data in continuous site improvement.*
- *Survey questions (as well as the profile) should be reviewed based on changes to the site and evaluation data expected.*
- *As updates are made to the site, face-to-face evaluations should be conducted in order to observe interactions and to receive feedback from facilitators regarding ease of navigation and usefulness of activities.*

Site Technical Maintenance

The following is a brief description of the tools and applications used in the development of this project. The designers provided sufficient information for an Information Technologist to understand the basic architecture and technical features of this product for the purpose of continual technical development. Where applicable, possible alternative applications to the ones used in the prototype design were suggested.

Platform: Windows NT 4 running on Novell Network Server.

- *Maintenance Suggestions:* All site HTML and graphic files should be transferred to a Navy server for ease and control of ongoing site maintenance.

Web Interface: The site is optimized to run on MS Internet Explorer and/or Netscape Navigator browsers.

Development Applications:

Microsoft FrontPage 2000™

Macromedia Fireworks 3™

Hypertext Markup Language (HTML)

Macromedia Flash 4™

Notepad

Microsoft Access 2000™

Adobe Photoshop 5.5™

Visual Basic Scripting™

Web Crossing™

There are various online course development software applications that have also gained popularity. WebCT, Blackboard CourseInfo, Phoenix Pathlore, and Construe are just a few examples. Alternatively, this site was created with a variety of COTS products that allowed design flexibility for ultimate user customization.

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NEEDS ASSESSMENT FOR DESIGN AND DELIVERY OF SITE-BASED TECHNOLOGY-SUPPORTED SCHOOL IMPROVEMENT DEGREE PROGRAMS

Jane Zahner
Valdosta State University

Introduction

With schools' increasing accountability for student achievement comes increasing pressure on teachers and administrators to know how to effect the needed changes. This paper describes the needs assessment activities that informed the design and development of M.Ed. and post-master's degree courses and programs to be delivered onsite and through distance technology support in rural areas. Two partner school systems participated in the needs assessment with three more currently involved in the programs. Participating school systems range in size from less than 1000 K-12 enrollment to just over 3000. The University partner in this project is Valdosta State University, a regional university in South Georgia with an enrollment just under 10,000. VSU has a large teacher education program, enrolling over 3000 undergraduate and graduate students and providing training for a significant percentage of the educators in the largely rural, economically limited 41 county area covering 1/3 of the geographic area of Georgia.

In spring 2000 nearly 200 teachers and administrators enrolled in a needs assessment course offered by the Department of Curriculum and Instructional Technology. Some of these educators were already involved in systematic school improvement processes at their schools, others were not. They enrolled in the course with the expectation that full site-based graduate programs were in the design and development phase and would incorporate the needs assessment course as a part of the eventual program of study. In essence, students began the program on a promise that the University would deliver the goods. What those goods would be was to be based upon the results of needs assessment activities taking place concurrently with the course. Thus, students were in a unique situation of simultaneously studying needs assessment as an academic topic, conducting needs assessment as a part of their own school improvement process and being involved as subjects in a needs assessment conducted by the author.

In fall 2000 the promise was fulfilled. Participants began to earn graduate degrees in the School Improvement Degree Programs by taking innovative courses offered onsite at their rural school systems and through distance technologies. They are enrolled in degree programs designed and developed to specifically improve their own schools and systems, while increasing their own professional knowledge and competence. The programs, courses and modules were designed based on the extensive school-based needs assessment conducted during the spring course. Partnerships among school personnel, teacher educators and instructional designers have led to programs that are inclusive, team building, action-oriented and flexible. Several other school systems in the region have asked for the programs to be phased in during the next two years.

Needs assessment methods

This paper briefly describes the needs assessment methods, procedures and results. Samples and excerpts from the needs assessment instruments are included in order to assist others who are doing similar work. While one direct outcome of the needs assessment was an initiation of a design and development competition for technology-delivered course modules, that process is described only briefly. For more information about the courses, modules and programs contact the author of this paper.

A systematic curricular and instructional needs assessment was conducted at two rural school systems during Spring Semester 2000. The purpose of the needs assessment was to gain guiding programmatic input from all stakeholders. This input was essential in order to identify the educational

courses and programs required to best meet the educational needs of the individuals enrolled in the program and to achieve the educational outcomes of the school systems involved. In addition, the needs assessment process, data and resulting report established the framework for the "charter" degree program proposal submitted to the University System of Georgia Board of Regents.

Phase One of the needs assessment was really a 'wants assessment' (see Phase one: Demographics and wants assessment). Participants (n=165) were first asked what professional development / coursework would be most useful to them personally. They were asked to include the title and content as well as recommendations for delivery method, instructor, and other participants. This survey also asked for name and contact information, number of years as a teacher, number of years in current position, subjects taught, grade levels taught and leadership roles, if any. The results of this survey were compiled, categorized and distributed to the participants. This served as a discussion topic for groups as they examined their personal needs/requests in the context of school improvement needs indicated by the school profiles they were building during the course. The results of this survey indicated a wide variety of professional development 'wants' with teaching/managing multiple ability levels, time management and technology most often mentioned.

Phase Two of the needs assessment consisted of a survey which asked teachers to identify the grade-appropriate knowledge/skills their students lacked at the beginning of the school year (see Phase two: Student readiness). Analysis of these data resulted in a narrative that described the observed skill deficiencies across P-12 educational levels. Reading and math skill deficiencies were observed spanning the entire curriculum. This narrative was shared with the participants and incorporated into their data gathering for the ongoing School Improvement process.

Participants in small within-school groups held peer-led discussions in Phase Three of the needs assessment (see Phase three: Professional development needs based on School Improvement Plan). Groups were asked to generate five content areas appropriate for School Improvement Degree programs with justification based on documented school improvement needs. They included a short description of the content, target audience and specified delivery options from a given list. Results of this survey generated the following broad categories of professional development/ coursework have been identified as needed to support school improvement goals.

School Improvement Areas of Need

- Curriculum Alignment
- Differentiated Instruction (grouping, at-risk, etc.)
- School-Business Partnerships
- Instructional Strategies (teaching strategies, direct instruction, specific programs, etc.)
- Analyzing Test Scores
- Alternative Assessment (portfolios, rubrics, etc.)
- Cultural Diversity
- Reading Strategies
- Writing Strategies
- Math Strategies and Curriculum
- Motivation
- Test Taking Strategies
- Parental Involvement
- Critical Thinking Skills
- Technology Literacy
- Reference Materials
- Legal Issues
- Team Management
- Interaction With Parents
- Time Management
- Classroom Management

Phase Four asked individuals to judge and report competence in 11 general computer skills and 9 computer skills dealing with Internet use (see Phase four: Computer skills/resources checklist). The Checklist also asked participants to report on the type and quality of computing resources available to them at school and at home as well as their learning preferences in regard to technological delivery of instruction. Findings from analysis of the data produced by this checklist indicated that some individuals would need extensive basic computer instruction in order to participate in instruction using significant technological delivery. However, findings also indicated an overall fairly high level of computer skills competence and a very high level of computer access including Internet access. Participants also indicated a great deal of interest in technological delivery of program instruction, with a concurrent need for peer and instructor contact as well.

In Phase Five of the needs assessment activity, focus groups and peer-led discussion groups involved all participants in multiple assessments. Participants were assigned to these focus groups and discussion groups based on the demographic information collected in Phase One. The needs assessment coordinator facilitated three consecutive focus groups (see Phase five: Needs assessment coordinator-led focus groups). The first group consisted of selected counseling, special education, social work, and speech language professionals to discuss the needs for content from their areas of expertise to be shared with the rest of the school. The second focus group brought together reading teachers to generate ideas for extending reading instruction across all courses/levels. A third focus group, composed of teachers at 'transition' grades from elementary to middle and middle to secondary, generated ideas for the improvement of communication between school levels. Three peer-led discussion groups were going on concurrently with the focus groups. The first (see Phase five: Peer discussion group A) guided participants to respond to expert-suggested 'best practices' within content areas, the second resulted in generation of ideas about professional development needs based on career level and years of service (see Phase five: Peer discussion group B), and the third required participants to create a rubric suitable for judging educational computer use and program ideas for moving teachers to higher levels of computer competency (see Phase Five: Peer discussion group C).

Needs assessment instruments

The following are examples of either entire needs assessment instruments or excerpts from them. In many cases the format of the instrument has been altered to save space in this paper. For more information concerning the administration of these instruments or the analysis of the data collected through their administration, please contact the author of this paper.

Phase one: Demographics and "wants assessment"

Recall: A need is a gap between what is and what ought to be. In order to design the School Improvement program and courses to meet your individual needs and the needs of your school, your input is essential. Tonight and during the next few weeks, I will be asking you to contribute information and ideas about what will make this program work for you.

I've been asked to design a needs assessment that includes all relevant stakeholders in this process. I'll be asking you to complete short surveys; I may ask that some of you participate in focus groups with me; I may request short telephone interviews with some of you. All the work you've been doing in collecting information for your school profile will be used, as will your work on the school mission and vision. I'll also consult with administrators, college faculty and school improvement professionals in other programs. I'll look at the professional literature to see what successful School Improvement degree programs include and how they are structured.

Anyone who would like to discuss this needs assessment or to contribute ideas for the program and courses is welcome to contact me directly at __ or e-mail __. Your contributions will be taken seriously and be held confidential.

Please complete the short survey below and turn it in to the VSU faculty for return to me. Before you turn it in, please tear this sheet on the dotted line. I'd like for you to have this needs assessment description to keep, as well as the record of my telephone number and e-mail address.

Name ______________________________ e-mail ______________________

School ______________________________ work phone______________________

How many years have you been employed as a teacher? ________ How many years at this school?____________

Subject(s) currently taught____

Grade level(s) currently
taught____
Do you currently or recently act as a team leader, lead teacher or have other similar duties? Briefly explain.

(On reverse)
Imagine and describe a professional development course/activity designed just for you. Title? Content? Delivery (in class, hands-on, Internet, etc.)? Length? Instructor (generally, who)? Other participants (generally, who?) What need would it serve?

Phase two: Student readiness

Grade level: ____________________________ (If system or multiple grade levels, please indicate)
In a previous survey, some of you indicated that you are faced with challenges in teaching students of multiple abilities in your classes. This survey is intended to ask your observation of areas for which your students may need more and/or different instructional preparation. (If you don't teach self-contained classes, choose any observed student performance). Write about at least three examples of performance discrepancies and give as much detail as possible.

What grade-level-appropriate knowledge/skills did your students lack at the beginning of this school year? Description of content? Description of student performance?

Phase three: Professional development needs based on School Improvement Plan

This survey should be done in groups of 10-15 with a facilitator leading, organizing, summarizing & recording. Each group should hand in one document that reflects their collaborative work.

- Generate five content areas for coursework appropriate for the School Improvement Degree programs, both M.Ed. and Ed.S. Be sure that you could justify the content based on documented school improvement needs.
- Include a short description of the target audience for this coursework, if not appropriate for all participants.
- Check the delivery method or combination of methods you think would be most effective for the content.
  ___3 hr. course offered over entire semester
  ___3 hr. course offered in 1/2 semester
  ___Multiple-session workshop
  ___Single-session workshop
  ___Self-paced module
  ___Peer-Supported study group
  ___Other

Phase four: Computer skills / resources checklist

The School Improvement Degree Programs Needs Assessment is being conducted to investigate course and module delivery possibilities as well as content needs. There are many ways instructional technology could assist program delivery including use of the WWW, CD-ROMs, video, e-mail and on-site hands-on lab courses. This checklist is to gain information about your current computer skills and the computing resources you have readily available to you. NOTE: No decisions have been made to use technology in delivery; this is exploratory only.

Here is a list of general computer skills that would be useful for success in technology-integrated instruction. Read each item and indicate the response which best describes your current ability.

I can:

• Start up, reboot, and shut down a computer	Yes	No
• Start and quit a program stored on the hard drive	Yes	No

- Save and retrieve files to and from a floppy or the hard drive — Yes No
- Cut/copy text from one source and paste it onto another — Yes No
- Open and close menus and windows — Yes No
- Move and resize windows on your desktop — Yes No
- Navigate a directory structure to find files — Yes No
- Type at least 40 words a minute — Yes No
- Create a word processing document — Yes No
- Print a word processing document — Yes No
- Use spell and grammar checking to revise my work — Yes No
- Log onto the Internet — Yes No
- Retrieve and delete e-mail messages — Yes No
- Create, send, forward and reply to e-mail messages — Yes No
- Distinguish between an e-mail address and a web address — Yes No
- Send group mailings — Yes No
- Post messages to discussion lists — Yes No
- Locate and access information using a WWW search engine — Yes No
- Check the credibility of Internet resources — Yes No
- Locate and use appropriate computer resources and technologies within a library or media center — Yes No
  Yes No

This section asks about the computer resources that are available to you at home and at school.

21. Which of the following describes your home computer? (Check as many as apply)
    ___Do not have home computer
    ___Computer has modem
    ___Computer has CD ROM Drive
    ___Computer has sound card & speakers
    ___Computer has printer
    ___Phone line available to computer
    ___Connected to Internet Servi ce Provider
    ___E-mail account

22. Which of the following describes your classroom computer? (Check as many as apply)
    ___Do not have classroom computer
    ___Computer has modem
    ___Computer has CD ROM Drive
    ___Computer has sound card & speakers
    ___Computer has printer
    ___Phone line/network line available to computer
    ___Connected to Internet Service Provider
    ___E-mail account

This section asks about your instructional preferences in the area of course or module delivery via computer technologies.

23. When I am asked to use software or technologies that I haven't used before (such as e-mail, VCR):
    a. I look forward to learning new skills.
    b. I feel apprehensive, but try anyway.
    c. I put it off or try to avoid it.

24. If I had to describe my predominant learning style/preference, I would say it is:
    a. Auditory - I learn best when I can listen to an explanation of a concept.
    b. Visual - I learn best when I can read the course materials or view graphics and other visuals.
    c. Tactile - I learn best by "doing".

25. Having face-to-face interaction with my instructors and peers is:
    a. not particularly important to me.
    b. somewhat important to me.
    c. very important to me.

What are your ideas about how technology could be useful in delivery of the School Improvement Degree Programs? What are your concerns?

Phase five: Needs assessment coordinator-led focus groups

In this activity, held simultaneously with other Phase 5 activities, participants were grouped as described below. The needs assessment coordinator acted as leader and recorder within a 40 minute time period. The following questions provided the framework for the focus groups.

Focus Group: "Support for You"
Participants: 8-10 selected counseling, special ed, social workers, speech/language, etc. across schools and levels. Groups are homogenous by support function.

General Questions:
1. In what content from your area do other school personnel need training?
2. Who needs training?
3. At what level(s)?
4. How can your needs be addressed in a school improve ment program?
   - Professional development needs?
   - Restructuring of time, resources
   - New curriculum materials?

Focus Group: "Reading for All"
Participants: 8-10 selected reading teachers or personnel in reading support areas (media specialists) across schools and levels. Groups are homogenous by function.

General Questions:
1. In what content from your area do other school personnel need training?
2. At what level(s)?
3. Who?
4. How can your needs be addressed in a school improvement program?
   - Professional development needs?
   - Restructuring of time, resources
   - New curriculum materials?

Focus Group: "Transitions"
Participants: 8-10 selected teachers from $5^{th}/6^{th}$ grades or $8^{th}/9^{th}$ grades. Groups are homogenous by teaching assignment in a grade which transitions from elementary school to middle school or middle school to high school.

General Questions:
1. How can your needs be addressed in a school improvement program?
   - Professional development needs?
   - Restructuring of time, resources
   - New curriculum materials?
2. How can communication be improved between teachers at different schools?

Phase five: Peer-led discussion group activity A

In this activity, held simultaneously with other Phase 5 activities, participants were grouped (maximum of five persons per group) by content interest and grade level responsibilities. Each group was given a list of 'promising practices' in teaching and learning in their areas earlier identified by experts (teacher educators and arts and sciences content faculty). They were asked to select a leader and a recorder, conduct a discussion and construct written evidence of the results of their discussion within a 40-minute time period. The following questions provided the framework for their discussions.

Needs Assessment Summary: Promising Educational Practices

- What methods/ideas were most familiar to your group members? Give examples of ways group members have used familiar methods/ideas.
- What methods/ideas were least familiar to your group members?
- Which methods/ideas are applicable across educational levels (s)? Which are not, and why?
- How did you rank the attached methods/ideas according to group interest in further study?

Phase five: Peer-led discussion group activity B

In this activity, held simultaneously with other Phase 5 activities, participants were grouped (maximum of five persons per group) by years of experience in teaching. They were asked to select a leader and a recorder, conduct a discussion and construct written evidence of the results of their discussion within a 40-minute time period. The following questions provided the framework for their discussions.

Newcomer, Mid-Career and Seasoned Veteran?

- What are some of the professional development activities by group members in the last 2 years?
- What did the group decide were the top three activities and why?
- How might the professional development needs of your career-level category differ from those of other teachers?
- How might the professional development focus of your school/system need to change to facilitate school improvement?

Phase five: Peer-led discussion group activity C

In this activity, held simultaneously with other Phase 5 activities, participants were grouped (maximum of five persons per group) by convenience. Each group was given the following activity to complete. They were asked to select a leader and a recorder, conduct a discussion and construct written evidence of the results of their discussion within a 40-minute time period.

Build a rubric

A rubric is a way of describing what performance 'looks like' at various levels of achievement. For example, the following might be a rubric to evaluate the "Performance of Automobile Drivers".

Level 1: Novice	Level 2: Home Town	Level 3: Standard	Level 4: Expert
Has driven a few times accompanied by an instructor. Must be reminded to signal, maintain steady speed, park correctly and yield to traffic. Is worried and uncomfortable about having to drive.	Drives occasionally in familiar locations. Often fails to signal, maintain steady speed, park correctly or yield to traffic. Is uncomfortable driving at night, in rain or fog, or in moderate traffic.	Drives regularly and competently in generally familiar locations both day and night. Seldom fails to signal, maintain steady speed, park correctly or yield to traffic. Is uncomfortable driving in adverse conditions including unfamiliar locales, inclement weather and heavy traffic.	Drives daily with confidence and expertise. Always signals, maintains steady speed, parks correctly and yields to traffic. Can easily adapt to driving in adverse conditions including darkness, unfamiliar locale, inclement weather and heavy traffic.

Your Task

What you are to do, as a group, is to build a similar rubric to describe levels of expertise in using computers, either in the classroom or for your own personal productivity at school or at home. You may want to discuss computer use as a whole or, even better, choose a more specific topic like Internet use, word-processing, curriculum/technology integration, database use, etc. Once the rubric isbuilt you will use it to look at your own skill levels and generate ideas for professional development.

- Choose your topic.

- Decide on and name your levels of performance.
- Discuss what a teacher 'looks like' at various levels of performance.
- Write the description of the teacher performance at the various levels.
- Discuss where each of you 'fits' within the rubric.
- Mark an "X" on the rubric for the current level of performance for each group member (no names).
- Generate ideas for what kind(s) of courses/modules offered through the School Improvement Degree Programs would be needed to move teachers to higher levels of competency on your rubric.
- Generate ideas for what kind(s) of resources (hardware, software, facilities) would be needed to move teachers to higher levels of competency on your rubric.

Groups build rubric on supplied form and answer the following open-ended questions.

- What kind(s) of courses/modules offered through the School Improvement Degree Programs would be needed to move teachers to higher levels of competency on your rubric?
- What kind(s) of resources (hardware, software, facilities) would be needed to move teachers to higher levels of competency on your rubric?

Summary

Program and course development for the School Improvement Programs proceeded based on the results of the needs assessment. It was decided that the courses had to be flexible in order to address the documented school improvement needs of the teachers, administrators, resource personnel within the schools and school systems involved. To meet this need for flexibility some courses in the School Improvement Degree Programs were constructed from or include modules of varying lengths. Each program participant selects modules based on relevancy to his/her teaching and the needs of grade level or content teams or groups. In order to assure consistency and quality, modules were developed according to a template. Instructors were encouraged to adapt existing modules on the same topic building knowledge and skills from module to module. Faculty developing modules were given guidance in developing modules within the template, earned a stipend, and were supported in assembling the modules for duplication, storage and delivery. Designer/developers of modules were required to teach the module the first time through and revise based on formative evaluation data. They may or may not be assigned to teach the module at later points in the school improvement program.

The combination of extensive involvement of teachers and administrators in the design of their professional development within the framework of student achievement has powerful potential. Each year school systems in Georgia write consolidated grant applications that are based on and aligned with their school improvement plans and progress indicators. The integration of this process with the School Improvement Degree Programs has broadened participation in the process of gathering and analyzing student achievement data and has increased interest and individual responsibility for the results.

While the results are not in as to whether these School Improvement Degree Programs will have an impact on the bottom line of student achievement at least the right people are now looking for that impact -- the teachers and administrators themselves in partnership with the University.

Support and Training for High-School Faculty Who Will Teach Using the Web

Zane Olina
Arizona State University
Herb Dwyer
Tempe Union High School District
Wilhelmina Savenye
Arizona State University

Session Objectives

The purpose of the presentation is for AECT participants to learn:

5. *About the major barriers that teachers face when trying to incorporate web-supplemented and web-based teaching into the school curriculum;*
- Practical strategies for providing adequate support and training to teaching staff on implementation of web-supplemented and web-based instruction in secondary schools.

Background of the Virtual School Project

Over a six-year period, a team of staff members in a high school in the Phoenix, Arizona, area explored ways to improve student success while simultaneously reducing instructional costs. Technology as a tool for change played a significant role in most of the solutions that were explored. Increasing access to computers and the internet by students both at school and off-campus resulted in a proposal for implementing both web-supplemented and web-based instruction on a school-wide basis.

During the first phase of the project, emphasis was on piloting two classes/teachers. One teacher began to develop web-supplemented instruction for a freshman English class. The other joined the faculty of The Virtual High School, a consortium project administered through the Concord School District in Concord, Massachusetts, that offers web-based, advanced level high-school courses to students from all across the United States. It is envisioned that the second phase of the project will expand to involve all high schools in the district.

From the start of the project it has been clear that technology is simply a tool rather than a replacement for superior instruction. Teachers have been and will be the primary providers of good instruction. Yet, the major missing component in most technology-integration projects in schools has been a lack of adequate teacher training and support (Office of Technology Assessment, 1995; President's Committee of Advisors on Science and Technology, 1997).

The Teacher-Support Component

The focus of the proposed presentation is on teacher support. Based on the preliminary work of the school-district technology personnel, it was decided to conduct a thorough review of approaches and strategies for teacher professional development and support in technology integration. It was envisioned that this study would further inform the decision-making process regarding the implementation of web-based and web-supplemented instruction at the high school and across the district. The investigation was carried out as a class project in an advanced graduate-level instructional-design class. The class project represents the beginning of a district-university collaborative effort. This presentation will describe the major findings of the investigation and offer practical strategies for teacher professional development and support.

Needs Assessment and Content Development

During the teacher-support investigation, data were collected from four main sources. First, a review of relevant print and online resources was carried out. Secondly, the review of theoretical and applied articles was supplemented by analysis of individual case studies of professional-development programs or resources available for teachers on the web.

Interviews were conducted with five teachers at the high school. These teachers were identified by the campus technology coordinator as the core cluster of teachers who had expressed interest in using computers in the classroom. The teachers were asked about their concerns regarding the use of computers in teaching, their training needs and the types of support that they would need for implementing web-based and web-supplemented teaching in the classroom.

Data from five school or district-level technology coordinators and two faculty instructional-support staff members were also collected through interviews or an e-mail questionnaire. The respondents were asked about major barriers that teachers face regarding integration of computers, training needs and best practices for providing professional development opportunities, support, and incentive systems to teachers.

Findings

A brief summary of the main findings is presented below.

Major Barriers to Technology Integration

The most common barriers to technology integration in teaching are the increased preparation time, a lack of awareness of the general benefits of distance education, faculty compensation and incentives, access to appropriate technologies, a lack of shared vision for distance education in organization, institutional barriers and lack of support staff to help course development (Berge & Muilenburg, 2000; Moore & Kearsley, 1996; Office of Technology Assessment, 1995).

According to both the literature sources cited above and the accounts of the teachers and technology coordinators, the lack of time appears to be the single major factor hindering technology integration. Robinson (1995) suggests that development of information technology in education can be seen as part of the broader field of educational change in which there is a rich and useful literature (Fullan, 1993). Thus technology-integration efforts should be addressed as part of systematic efforts at improving *classroom practice.*

Teacher Training Needs

The University of Illinois Faculty Seminar Report (1999) highlights two distinct features of online pedagogy. First, the teaching paradigm must change from the traditional lecture format to one more suitable for online instruction. Secondly, the instructor has an important role in moderating the interaction. Porter (1997) suggests that only educators possessing certain qualities can be successful distance-learning instructors. Such qualities include the ability to learn new technology, a performance personality, flexibility, and time to create new materials and methods.

Training Models

Teacher training should focus on the use of technology in teaching rather than acquisition of skills using software (OTA, 1995; The President's Committee of Advisors on Science and Technology, 1997). No single approach is best for effective teacher professional development (OTA, 1995) and a variety of approaches should be used in combination at any given time. Some common strategies are developing technology rich classrooms as demonstration sites, training master teachers who then serve as resources to their colleagues and providing access to technical support staff.

Support Systems

Support systems should primarily address the major barriers to technology integration mentioned above. Unless a systemic approach to technology integration is adopted individual teacher training initiatives are likely to be ineffective. Providing time for experimenting with new technologies, and the support and incentives for doing so, are some of the most effective strategies. The report prepared by University of Illinois (1999) emphasizes the need for recognizing faculty intellectual property rights as the best way of assuring high quality of online teaching.

Implications for Teacher Professional Development and Support

The literature review, the interviews with the teachers, and the conversations with the technology coordinators have demonstrated that in order for technology integration to take place a comprehensive and systemic approach is necessary. A number of practical suggestions for implementing teacher training and support for web-based and web-supplemented teaching follow. The suggestions are presented in three broad categories: setting the stage, training strategies and support systems for sustaining change.

Setting the Stage

Set a Clear Vision

Have a clear vision of what your priorities are at the school or district level. Then examine ways in which technology can help you accomplish those broader goals. .Unless teachers see the link between improving quality of teaching and learning and use of technologies in the classroom any technology integration efforts are mots likely to fail.

Start in Small Steps That Ensure Success

Start in small steps by encouraging teachers to initially put their syllabus and class assignments on the web, or to create brief online quizzes, or begin using electronic grade books. Then provide them with a bigger picture of what the next steps in progression might be.

Evaluate Progress Against Initial Goals

Monitor the progress and measure the success of technology integration based on the initial goals. Technology integration is not about the number of computers in each classroom or about the number of internet connections it is about a better quality of teaching and learning.

Involve Faculty in Decision Making

Involve faculty in formulating the vision and setting priorities for your school as much as possible. Hiring external instructional designers and web developers may seem to be a quicker and more efficient short-term solution. Yet, this approach does not empower teachers to try out un-conventional instructional strategies or to model effective technology use to their students.

Establish External Partnerships

Establish external partnerships with local universities and businesses for additional expertise and support. For example, graduate students from universities can provide instructional design expertise to teachers for course development. Businesses can let teachers attend their training events or provide volunteers to coach teachers on technology skills.

Allocate Adequate Resources for Professional Development

US Office of Technology Assessment recommends that at least 30% of technology funds be spent on training. Provide teachers with release time for jump-starting new web-based courses, or stipends for attending training workshops. Compensate teachers instructing their colleagues on technology skills for planning time and training that they provide after school hours.

Provide a Common Set of Course Development and Delivery Tools

Consider adopting a commonly used courseware package such as Web CT, CourseInfo or others for the entire school or district. Provide training and technical support for the users. A common courseware

package provides students with the same interface for all the courses offered and they are not distracted from core learning tasks having to master a variety of applications. A common set of tools requires fewer resources for training, support and management of web-based instruction.

Provide Adequate Infrastructure and Technical Support

Ensure that teachers have access to the necessary hardware and software tools for developing and implementing web-based and web-supplemented instruction. One of the models that has proven itself successful has been providing the teacher with a laptop and equipping the classroom with a minimum of five workstations with internet connection. In addition, in order for web-based and web-supplemented instruction to be successful students also need to have access to computers and internet outside the regular school hours. A high-speed server for hosting web-based course materials is also an absolute necessity once web –supplemented and web-based instruction becomes more widely spread at the school.

Training Approaches

Pick Your Trainees Carefully

Web-based instruction requires considerable investment in training and daily coaching. Select your trainees carefully, especially at the initial stages of adopting web-based instruction at your school. For the trainees to be successful and to serve as role models for their colleagues they should meet a number of criteria. The trainees should be:

- Open-minded and willing to continually learn new technologies and teaching approaches;
- Experienced teachers who are familiar with a range of teaching strategies in face to face situations so that they have a pool of ideas to pull from for web-based instruction;
- Familiar with the course content to be delivered entirely or partially over the web;
- Comfortable with technology;
- Capable of collaborating with others;
- Willing to share their experiences and expertise with their colleagues.

Use a Variety of Training Approaches

Provide a wide selection of training opportunities to satisfy the varied training needs of the teachers. Those already familiar with technology will need only additional encouragement and ideas for classroom applications of technology that can be provided over the web. Novice learners will need very specific initial training aiming at teaching very specific technology skills and their applications for the classroom and ample opportunities to practice these skills.

Provide Follow-up Support

Avoid stand-alone training events whenever possible. Instead, offer a series of training events enabling teachers to come back with questions and to try out the newly learned skills in practice. Provide follow-up support at the school or district level by making the trainer accessible at least a few times a month or by encouraging the participants to form local support groups.

Focus on Classroom Application of Technologies

Focus all training on the classroom applications of technology rather than mastering specific software programs. Emphasis on the application of internet or software programs in the classroom will provide context for the training and will help teachers apply the newly learned skills in practice.

Provide Plenty of Real-Life Examples

Provide teachers with a range of real-life examples and case studies of successful technology integration initiatives. Whenever possible, the examples should offer solutions to the challenges and concerns that teachers face in the classroom on a daily basis, such as lack of student motivation, varied ability and interest levels of a diverse student population, lack of time to provide immediate feedback on student assignments and others.

Model Technology Use

Model technology use during training by choosing the most appropriate delivery medium. If you are training teachers on web-based teaching then at least part of the training should be delivered over the world wide web.

Provide First Hand Experiences With Technologies

Best of all if teachers have the opportunity to participate in web-based training themselves in order to step into the students' shoes. If that is not possible provide as much hands-on experiences with web-based and web-supplemented instruction during your training as possible.

Just in Time Training Works Best

Timing of the training is important. Target the training primarily at those who will need to deliver web-supplemented or web-based teaching in the very near future. Best of all, design the training around the actual course projects that the teachers will be implementing to ensure direct application of the newly learned skills in practice.

Allow for Plenty of Time

Learning takes time and opportunities for trial and error. Allow trainees time to try out smaller assignments and be successful before launching into larger semester-long course design projects. Research shows that on average it takes around three to five years for teachers to become comfortable with technology.

Do Not Have the Same Expectations for Everyone

Do not expect every faculty member to integrate technology into his or her teaching to the same extent. Each teacher has his or her own set of values and instructional approaches to make him or her most effective in the classroom. Web-based instruction requires a major change in one's teaching and learning approach and the medium might not suit everyone.

Support Systems for Sustaining Change

Provide Ongoing Technical Support for Teachers and Students

Once web-supplemented and web-based courses are offered at a relatively large scale at the school or at the district both teachers and students must have access to a technology help desk by phone twenty-four hours a day. In addition to campus technology coordinators, school librarians or media specialists could be trained to provide necessary technical support. Librarians could also provide instructional support to teachers by locating useful web sites for instruction or coaching students on internet search skills or online study strategies.

Use Students in Faculty Support Roles

Ask motivated high school students with technology skills to assist faculty in putting their courses on the web. Students could undertake these tasks as independent study projects or as part of their school to work experiences.

Provide Opportunities for Sharing of Ideas and Information

Set up a curriculum and technology resource center at the district level where teachers could access to additional computers, software and information and advice regarding web-based instruction. Set up and maintain a support web site for teachers where they could access online tutorials, share lesson plans and plan collaborative course projects.

Consider Adequate Recognition and Rewards

Recognize teachers who excel in web-based and web-supplemented teaching as instructional innovators. Recognition in front of peers is one of the most effective means for rewarding an accomplished teacher.

Develop and Implement a Clear Intellectual Property Rights Policy

Develop and implement a clear intellectual property rights policy at the school or district level. Teachers should never feel that by developing online courses they will some day lose their jobs or that someone else will teach their courses. Before developing new online materials an agreement should be signed between the author and the school or the district as to who will own the materials once it is published online and how the materials will be used. The developer should always be asked for permission when his or her materials are to be used for other courses.

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Examining the Impact a Media Distribution System Has on a High School Classroom Environment: A Case Study

Robert Abraham
St. Charles East High School
Rhonda Robinson
James Lockard
Andrew Torok
Northern Illinois University

The Study

The site for this study was the west suburban Chicago metropolitan area. The school district was a unit district providing classes for students in grades K-12. There were 14 schools in the district with a new elementary school and new high school under construction at the time of this study. The high school, where this research actually took place, had an enrollment of approximately 3200 freshman to senior students.

For this study, 28 participants were interviewed. Of these participants, 13 were teachers, 11 were students, and 4 were adult support personnel, which included a library/media specialist, an assistant principal, a library assistant, and a computer technician. Survey data were also collected from 40 teachers who had access to the media distribution system. Teachers reported on how often they used the system, what devices they used, and responded to evaluative statements on using the system.

The transcripts of the interviews were imported into a qualitative data analysis computer program. Interviews were then coded into 18 categories for retrieval and analysis. The information that emerged from the interviews and survey was divided into two areas, (a) the positive impact on the classroom and (b) the areas of concern that participants had about using the system.

Positive Impact

Based on the survey and interview data, the following summarizes what students and staff reported:

1. Classes didn't have to worry about sending and receiving carts of audio-visual equipment to and from classrooms. The ability to access the media distribution system was immediate.
2. The system was easy to use from a staff and a student perspective.
3. Class time was interrupted less by scrolling the daily announcements over the system rather than someone reading announcements over the PA system.
4. It allowed class instruction to be more spontaneous. The "teachable moment" didn't have to get away, the class now had immediate access to a variety of multimedia tools.
5. Teaching styles became more hands-off while student participation styles became more hands-on.
6. Cable TV allowed classes to view world events and late breaking news as it was happening.
7. The media distribution system helped address the learning styles of visual learners. Teachers were able to present material in a variety of ways.
8. A classroom with a media distribution system was more efficient than a traditional classroom.

9. Classes were more judicious in their use of video. Students were more likely to view snippets of video when they had access to a media distribution system.

10. The ability to network classrooms, to view media in multiple classrooms at the same time, was beneficial.

11. Teachers reported the positive effects for students using the system that included the following:

    - Students found it easier to present electronically. Students were able to move from posterboard speeches/presentations to multimedia presentations.
    - Using the system placed the attention of the class on the information and not the student.
    - Using the system allowed students to follow their interests in preparing for presentations.

Survey statements number 1 and 16 related to the overall impact on the classroom environment. In statement one, 23 participants (72%) agreed that they were very happy with the media distribution system and its capabilities. And in statement number 16, 24 participants (77%) said that the overall impact of the system on the classroom environment had been positive.

Finally, the teachers' comments say much about using a media distribution system. For example, teacher number nine stated that "it has changed teaching and learning in our class." Teacher number two voiced, "It makes you a better teacher, it makes your class a better classroom." And, teacher number seven stated:

> To me I guess it's kind of a continual development. It's evolved from the television on a cart thing, to this. What the next step is, I'm not sure. But the point is that this is a definite improvement over where we were.

Areas of Concern

Based on the survey and interview data, the following summarizes what students and staff reported:

1. Having to give up the control of loading the videotapes into the VCR was an issue expressed by both teachers and students. Participants did not like the fact that the VCR was not in the classroom and they gave up this control to the people in the Resource Center.

2. Teachers said that the 27-inch monitor size was too small. No student reported having a problem with the monitor size.

3. Sixty-two percent of the teachers surveyed said they don't really need all of the bells and whistles included in a media distribution system. They just need a TV/VCR in their room and it would take care of most of their media needs.

4. There was a strong perception that the media distribution system is just for showing videotapes. Comments like, "Wouldn't it be cheaper to have TVs and VCRs in each classroom?" reaffirms this perception.

5. Only 12 teachers (41%) thought the inservice training they had received on the media distribution system was appropriate for them to use the system.

6. Teachers were interested in additional training, 19 teachers (59%) reported they were interested in more inservice training on the media distribution system.

7. There are some issues in running and maintaining a media distribution system including:

- Sensors can come loose.
- There is no battery indicator in the remote to know when they need replacing.
- Human error in scheduling or loading the system.
- CCM box at the top of the monitor can be disconnected.
- Students "play" with the buttons on the front of the TV.

8. The wireless keyboard used to access the computer at the head end was very cumbersome to use.

9. There is a cost of maintaining the media distribution system when the school personnel are unable to fix hardware or software problems. An outside company needs to come in to complete repairs.

When Buying

Based on the results of this study, there are several important points that a school should consider before purchasing a media distribution system. These would include the following:

- Plan to have a computer connected to each classroom monitor. A media distribution system is a presentation system for both students and teachers. A computer will enhance the potential of the system by: (a) giving the teacher the ability to schedule media from the classroom and (b) the ability to show computer images to the class. Purchase the computer with a TV card. This will allow the user to connect to the TV with just an RCA cable.

1. Purchase the largest monitor that is practical for the budget. At the site that this study was conducted, 27-inch monitors were installed. Some of the teachers thought that this size did not provide adequate viewing for the entire room. A larger monitor will provide a larger viewing area for the classroom. A school should also have the option of connecting an LCD projector to the system. An LCD projection system in the classroom will allow for a significantly larger viewing area.

2. Consider the monitors that accept a computer signal. Traditionally, to show a computer image on a TV screen, a scan converter was needed to convert the computer signal to a signal that the TV monitor could "understand" or show. Some monitors will accept the computer signal and provide much better resolution when showing computer images. Students and teachers will appreciate the better resolution.

3. Purchase monitors without buttons on the front of it. Or, some monitors let the user internally disable the buttons. This will be less of a distraction for students who want to explore what each button does.

4. One of the negatives that came out in the study was that teachers did not like the idea of giving up control of the videotapes to the personnel operating the system. A school could consider providing VCRs with some of the monitors, especially if a teacher uses many videotapes during a specific class. The price of VCRs have come down to a point that would make this idea more possible.

5. Inservicing the teachers is a key to the successful operation of the media distribution system. Although the system is easy to use, the more that teachers know of how to use the system, the greater the potential for teaching and learning. Plan on initial training and also follow-up training once the teachers have acclimated to the system.

Written Survey Data

The following are the teacher responses from the anonymous survey.

This study can be viewed on the World Wide Web at: http://www.inil.com/users/bobmm/dissuse.htm

Media Devices Used

	Daily		Weekly		Monthly		Never		Total Responses
CDI Player-Encyclopedia	0	0%	0	0%	4	13%	28	88%	32
CDI Player- Audio CD's	0	0%	0	0%	5	16%	27	84%	32
AM/FM Tuner	0	0%	3	9%	2	6%	27	84%	32
VCR	2	6%	14	44%	16	50%	0	0%	32
Laser Disc Player	0	0%	1	3%	4	13%	27	84%	32
Still Video Floppy Player	0	0%	2	6%	7	22%	23	72%	32
Computer to Monitor	0	0%	1	3%	5	16%	26	81%	32

Cable Channels

	Daily		Weekly		Monthly		Never		Total Responses
History Channel	1	3%	0	0%	0	0%	31	97%	32
CBS	1	3%	0	0%	4	13%	27	84%	32
NBC	1	3%	0	0%	5	16%	26	81%	32
WTTW	0	0%	0	0%	6	19%	26	81%	32
WCIU	1	3%	0	0%	1	3%	30	94%	32
CNN	0	0%	2	6%	9	28%	21	66%	32
Weather Channel	0	0%	1	3%	6	19%	25	78%	32
Arts & Entertainment	1	3%	1	3%	1	3%	29	91%	32
CNN Headline News	1	3%	1	3%	6	19%	24	75%	32
Discovery Channel	1	3%	0	0%	3	9%	28	88%	32

Survey Statement Responses

	SA & A		No Opinion		D & SD		Total Responses
1) Very happy w/capabilities	23	72%	4	13%	5	16%	32
2) Inservice appropriate	12	41%	7	24%	10	34%	29
3) Rather teach in an MDS room	22	69%	8	25%	2	6%	32
4) 27-inch monitor is large enough	16	52%	1	3%	14	45%	31
5) Would like more inservice	19	59%	6	19%	7	22%	32
6) Import. use engage learning	26	87%	4	13%	0	0%	30
7) MDS helps engage students	22	69%	9	28%	1	3%	32
8) More efficient w/MDS classroom	19	59%	9	28%	4	13%	32
9) Prefer just TV/VCR	9	28%	11	34%	12	38%	32
10) MDS provides rich media environ	21	68%	10	32%	0	0%	31
11) Believe in rich M/environ	28	88%	3	9%	1	3%	32
12) Prefer traditional classroom	4	13%	9	29%	18	58%	31
13) Efficient w/lessons using media	14	44%	9	28%	9	28%	32
14) Use more media	13	41%	8	25%	11	34%	32
15) 21st Century classroom	24	75%	6	19%	2	6%	32
16) Overall impact positive	24	77%	6	19%	1	3%	31

DESIGN, DEVELOPMENT AND EVALUATION OF A VIRTUAL HISTOLOGY COURSE

Regina Schoenfeld-Tache
Sherry McConnell
Colorado State University

Abstract

This paper describes the design and development of a distance-delivered, upper-level science course, and the results of a study conducted to determine its effectiveness relative to the on-campus section of the same course. This course takes advantage of the unique characteristics of the Internet by using it to transmit visual information and allow for asynchronous and synchronous interactions. The assessment conducted focused on content mastery and the effect of computer-mediated communication on type and depth of questions. No significant differences in academic achievement were observed between the two groups. However, the rate at which students and faculty interacted was much greater in the online sessions (chat and review), and a greater percentage of higher order questions were asked in the online sessions.

Introduction

WebCT Inc. recently recognized online Histology as an exemplary course due to its academic rigor and content robustness. This paper will briefly outline the design and development processes involved in creating the course and subsequently focus discussion on the results of a study comparing virtual histology to a traditional (on-campus) section of the same course taught simultaneously by the same instructor.

Course Design and Development

A needs analysis to determine the feasibility and value of offering an upper level science course via the Internet was conducted by one of the authors (SMC). She discovered a need for upper division science courses offered in an asynchronous format in order to meet the needs of students, mainly those of non-traditional ages and backgrounds, pursuing pre-health majors. Scheduling conflicts made it particularly difficult for students with family and work responsibilities to attend traditional on-campus science lectures and laboratories. Having taught Histology, a study of tissues, for many years in the on-campus environment, she was able to recognize its potential for conversion to online delivery. Given the nature of the subject, the course is image-intensive, making it ideal for Internet delivery. WebCT was selected as the delivery system because of its ability to offer controlled access and rapid downloading of images via its CDROM tool. The goal was to create an online course that would preserve the same objectives as the on-campus course while harnessing the unique properties of the delivery system to allow for other types of instructional activities. The resulting course emphasizes the concepts of histology rather than the development of psychomotor skills relative to physical manipulation of a microscope.

Although at the time of the study all required components (including examinations) were offered asynchronously (participation in chat sessions was optional), in its current form, the online histology course offers asynchronous lectures and laboratories and synchronous examinations and online discussions (chats). An expanded syllabus (a combination of a calendar, traditional syllabus and learning objectives) guides students and permits self-pacing. Lectures are designed to simulate real lectures instead of being a modified textbook. Clinical examples and everyday analogies emphasizing content applications are frequently inserted in the lectures. Students are guided by objectives and a text reading assignment for each lecture. At the end of each lecture, a humorous slide of the instructor leads students to the formative quizzes ("bonehead quizzes"), which provide them with instant feedback about their level of learning. These quizzes are not graded because they are designed to scaffold metacognitive skill development and add some humor to the lectures. Each week at a scheduled time, the students are invited to participate in an online discussion of current course topics. Chat sessions are well received by the students. The instructor leads

these sessions with questions about content. In addition, students are called upon to ask each other specific questions about the material. The result is the creation of a sense of community (there are often humorous asides and social interactions), where members support each other and value individual contributions to a group learning environment. During these sessions, students are confirming their level of knowledge and gaining insights about "how the instructor asks questions." On their own, students have started setting up additional online discussions each week.

Online Histology addresses a variety of learning outcomes, ranging from simple declarative knowledge to the development of higher-order cognitive skills, such as scientific problem solving. The manner in which the characteristics of the Internet were harnessed to address each type of outcome:

- Content knowledge: The distance class was a section of the traditional course. For the sections taught by SMC, both the online and on-campus courses covered the same material, had the same objectives, and had the same examination questions. The only difference between the online and face-to-face sections was the manner in which the material was presented. While most of the face-to-face instruction took the form of a didactic lecture, the bulk of online instruction was presented through visually stimulating web pages containing practical examples that allowed the learners to control the pace of instruction.
- Problem solving skills: Online science courses have been criticized for lack of laboratory experiences (Carr, 2000). In the online histology course, this problem has been overcome by the creation of an interactive online laboratory that provides an experience very similar to that of an on-campus histology laboratory. Using the Internet, a series of images captured at various powers of the microscope are sequenced and linked together to simulate the views from a microscope at different powers. The only difference between the online traditional laboratories is that students are not physically manipulating a glass slide and focusing a microscope in the online version of the course. Since these psychomotor outcomes may be of value to students pursuing careers in histology/pathology, an on-campus lab is offered as a supplement. However, the lack of psychomotor learning is more than compensated for by the increased amount of questions discussed in class and the greater depth of thought (and interaction with the content) demonstrated by students in the online class.
- Metacognitive skills: Learning science at a distance requires students to acquire higher order cognitive skills and metacognitive skills, such as reflective analysis, independent thought, time management and self-motivation. Frequent e-mail and online chat interactions with the instructor provide support for students while encouraging them to take responsibility for their own learning.

As part of the development process for this course, differences and similarities of online and on-campus environments were considered. There was a conscious attempt to create an inviting but challenging online environment that would parallel the academic rigor expectations of the traditional course. Almost 5,000 images were collected and inserted into the course in order to fully present the content in an interactive environment. Administrative and colleague resistance was encountered throughout the development process. Concerns of academic rigor, "seat time," appropriate generation of official credits, and how to assess faculty teaching in this medium for purposes of promotion and tenure were and still are encountered frequently in the development and implementation of this course. Finally, the instructor has always enjoyed interacting with students in her on-campus courses, and was concerned the opportunities for this type of contact might be diminished with the online course. The instructor was able to confirm that instructor-student interactions occurred with at least as much frequency in online environments as in the on-campus settings.

Course Evaluation

Recent trends (International Data Corporation, 2000) in distance education make it necessary to explore the effects of online delivery on students' academic and personal growth. Since an ever-increasing number of courses are being offered at a distance it is important to investigate the quantitative and qualitative effects of an online delivery medium on student outcomes.

The Histology course gave us a unique opportunity to extend the current research on distance education into the realm of advanced science courses – a topic of great concern in the current literature. We were able to investigate the effectiveness of the Internet as a tool to teach science at a distance, as well as

how the medium affected interaction among participants (students and faculty) thanks to the availability of parallel course sections taught by the same instructor.

Study Design

The research questions addressed in the study were:

- Is online delivery as effective as face-to-face instruction for science classes? Specifically, was there any difference in academic outcomes between the sections?
- How does computer-mediated communication affect interactions in an upper-level science class? Specifically, does it affect the number or type (depth) of questions asked?
- If there are any differences in interactions, how do these changes affect learning outcomes?

Participants in this study were students enrolled in either the on-campus or distance section of Histology at Colorado State University. Forty-four students volunteered to take part in the study. Of these students, 33 were enrolled in the on-campus section and 11 took part in the online section. Student participation was observed in three settings: face-to-face lecture (traditional instruction), online class (instructor-led synchronous discussion) and online review (student initiated study session, without instructor's presence).

In order to answer the aforementioned research questions, students in both sections were asked to complete a diagnostic quiz. This quiz provided a baseline measurement of all students' prior knowledge. The academic performance of students in the on-campus section was measured by their performance on relevant sections of a lecture exam (material taught by the participating faculty member). In-class interactions (questions asked) for this group were recorded by direct observation. Students in the online section allowed the researchers to access their exam results electronically. The conferencing software automatically recorded online interactions during chat sessions. In addition, students in the online section completed a course survey addressing their perceptions of this type of instruction.

Results

There was no statistically significant difference (=0.05) between the experimental and control groups on either the pre- or post-test. However, the amount of interactions (questions asked) varied greatly by setting. During face-to-face lecture sessions, an average of 18 interactions took place per hour. Online class sessions averaged 51 interactions per hour, and online review sessions had an average of 54 interactions per hour. Students assumed a more active role in the online sessions than they did during the face-to-face lectures, despite being specifically asked to participate in the lecture sessions. Students initiated 41% of questions during online classes, but only 34% during face-to-face lectures. When the topic of these questions was examined, it was determined that the questions asked during lecture sessions were almost exclusively focused on content topics (87%), and no social questions were observed in this setting. A student spontaneously assumed the role of facilitator during the review sessions, which led to a comparable amount of management interactions in both online settings (27 – 28%). The main difference between online class and review sessions was the shift of 10% of the interactions from content topics during class sessions to social interactions during the review sessions. An average of 66% of interactions were dedicated to content topics during the online class sessions, but only 56% during online review sessions. A more in-depth examination of the content interactions revealed that a substantial amount of interactions (60%) asked during lecture sessions were of a low cognitive level (levels 1 and 2 of Bloom's Taxonomy – knowledge and comprehension). Both the instructor and students asked a larger proportion of high-level questions (levels 5 and 6 – synthesis and evaluation) during the online class sessions than they did during the face-to-face lecture sessions. The vast majority of interactions in review sessions were at the lower levels of Bloom's Taxonomy

Conclusions

The instructor was able to overcome obstacles common to faculty-development of online courses by persistence and creativity. Her experiences can serve as an example of how faculty can develop exemplary

online courses regardless of level of computer skills. Ongoing feedback from students, and instructional design staff have resulted in ongoing modifications to best suit the needs of the students and the medium.

It is interesting to note that even though the instructor's presence had only a minor effect on the number and topic of interactions in each setting, her presence did cause a major shift in the level of thought reflected in the questions asked in each setting. Although the online review sessions had a higher frequency of interactions, these interactions consisted primarily of low-level questions which could be answered rapidly, both in terms of the amount of time required to think about the content and formulate a response as well as in the time required to physically type an answer.

The "anonymity" afforded by computer-mediated communication encouraged more in-depth thought and processing in student answers during the chat sessions. Students were more likely to participate, had more time to reflect and ask thoughtful questions compared to the lecture settings.

The main conclusion of this study was that it is possible to teach upper level science courses without sacrificing academic rigor. When face-to-face and online sections of the same course were compared, academic outcomes were the same, but the online classes demonstrated a deeper engagement with the content, and had a qualitatively different experience.

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ROOKIE CAMP: AN INTRODUCTORY UNIT FOR WEB-SUPPLEMENTED INSTRUCTION AT THE HIGH SCHOOL LEVEL

Mary Niemczyk
Arizona State University
Herbert Dwyer
Tempe High School District
Wilhelmina Savenye
Arizona State University

Abstract

Ease of use is critical to promoting success in computer-assisted instruction. The Rookie Camp unit is aimed at preparing high-school students for the WebCT working environment and provides explanation on how to be successful using WebCT. The unit was developed to introduce high-school students to the use of the icons and related course management tools on the "default" WebCT course homepage. This paper includes descriptions of the design, development and formative evaluation of the Rookie Camp unit. Implications for the future are based on the outcomes of the formative evaluation as well as findings from the literature review focusing on student support in computer- and web-assisted instruction.

Introduction and Project Background

Improving student success while reducing instructional costs can be a tremendous challenge for many higher-education institutions. It is interesting to note, however, that many high schools across the country are facing a similar challenge.

At one high school in the southwest, two staff members at the school teamed up to search for solutions to meet this as well as other academic challenges. Over a six-year period, they explored many scenarios, reviewed the literature, and participated in model projects. As a result of their efforts, they concluded that the use of technology in the classroom could possibly provide some solutions.

With the recent passing of a bond issue by the voters in the school district, funding for necessary capital equipment was secured. Among other things, the bond issue provided for installation of a high-bandwidth, high-speed infrastructure with access to the Internet during the 1998-99 school year. With the foundation in place, the challenge was on how to successfully utilize this system to meet the high schools' academic goals.

The team developed a proposal outlining ways to increase student success rates and decrease costs by using technology in the classroom. Some of the solutions proposed included providing web-supplemented additional learning activities and opportunities for students identified as "turnaround students", those students that are at risk of failing required courses. Other solutions offered opportunities for advanced students to take college level courses while in high school. Finally, web-based instruction could help those students who may not be able to be on campus for health, disciplinary, or other reasons.

Since it was unrealistic to expect teachers to become web developers immediately, the first project initiated was the development of a web-supplemented, rather than fully web-based, Freshman English class. The decision to begin with a web-supplemented course would allow for materials to be developed gradually, tested, evaluated, and revised (Dwyer & Boyle, 1999). Development of the course materials began in the spring of 1999 and the materials are being used at the present time.

Efforts to Expand the Use of Web-Supplemented Activities

The high school chose WebCT to be the courseware used for web-supplemented instruction. In an effort to increase the use of technology in the classroom, members of an Arizona State University graduate

class, Advanced Instructional Development, were brought in to assist. During the semester, we spent time at the high school speaking with the school administrators, media director, teachers and students. Based on our meetings, we outlined several projects that would be of value.

Focus on the Learner

Introducing and actually being successful in implementation of web-based courses is an arduous task. Many obstacles can present themselves quickly at the mention of utilizing the web as a tool for instruction. The difficulties may lie not only in gaining agreement with administration and faculty, but concern has to be given to the students who will be trying to increase their learning in this new environment.

Though it is probably true that many high-school students have some computer experience, relatively few have had exposure to using the web as part of their classroom instruction. In order to insure success, the learners need to be ready to work with this new tool. Learner readiness involves gaining competencies in using navigation tools and becoming familiar with the learning environment (Twigg, 1999; Winiecki, 1999).

In order to ease the transition to web-supplemented courses and promote success, the Rookie Camp unit was developed. This unit will become a "default tool" to be included in all WebCT courses at this high school. Rookie Camp will be the first unit the high-school students in web-supplemented courses will go through.

Description of the Rookie Camp Unit

This unit is centered on a school or "Camp" environment, including graphics of students taking notes and a cheerleader leading the Rookie Camp Cheer. The unit is designed to make learning both effective and enjoyable.

Rookie Camp is a self-instructional unit in WebCT. Directions are provided to the student throughout the unit, along with reminders of the goals of the unit. The student is also provided a Rookie Camp Reminder Card. The Rookie Camp Reminder Card is a single sheet with a graphic of each of the nine "default" WebCT course homepage icons. The student is encouraged to write notes next to each icon on the Reminder Card as he/she is working through the unit.

Rookie Camp Instructional Flow

The unit begins with a screen displaying the Rookie Camp title and asking the student to click on the "Course Materials" icon to enter Rookie Camp. (Figure 1) After doing this, the student is provided another screen with directions to click on the "Course Content" icon to begin using the Rookie Camp unit. This is the same manner in which the student will access all of their other courses in WebCT.

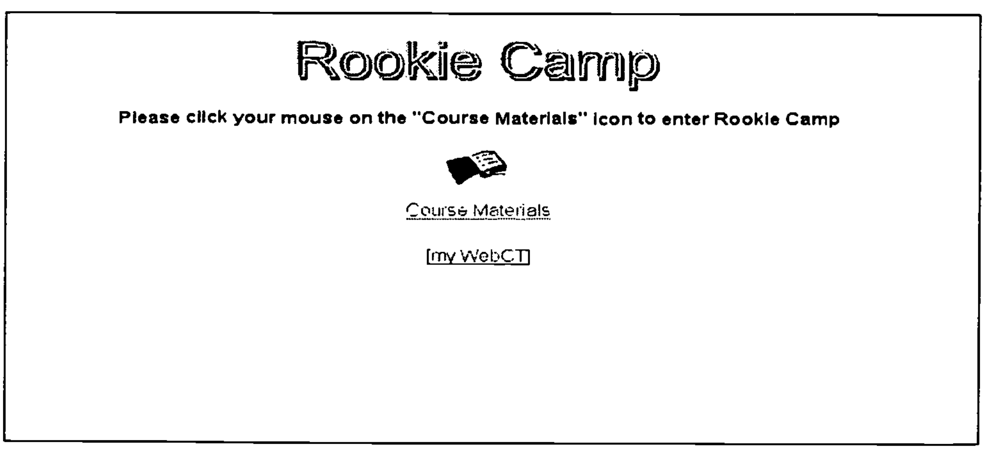

Figure 1. Rookie Camp Introduction

The student is then presented a Welcome screen with a description of Rookie Camp unit, followed by a screen, which shows a list of Rookie Camp Activities. The activities are an overview of the areas they will be working through in the unit. The student is then provided the actual learning objectives of the unit; after completing the Rookie Camp unit they will be able to provide the name of each of the nine "default" WebCT course homepage icons, and describe the tools the icons represent.

Since the student is not familiar with WebCT, WebCT and the "default" course homepage are explained. Next, the student is introduced to the Rookie Camp cheer: McClintock Chargers Can Sure Learn Cool Stuff As Required. The first letters of each word in the cheer represents the name of one of the nine WebCT icons. The student will be reminded of the cheer later in the program and told to use it as a learning tool, as it is a mnemonic device.

The student is then presented nine screens, each with a graphic of one of the icons and a detailed description of the uses of the icon. The descriptions provide information on how the student will use the tools represented by the icon for various course management functions. This section focuses on the actual learning objectives. A sample of an icon screen is shown in Figure 2.

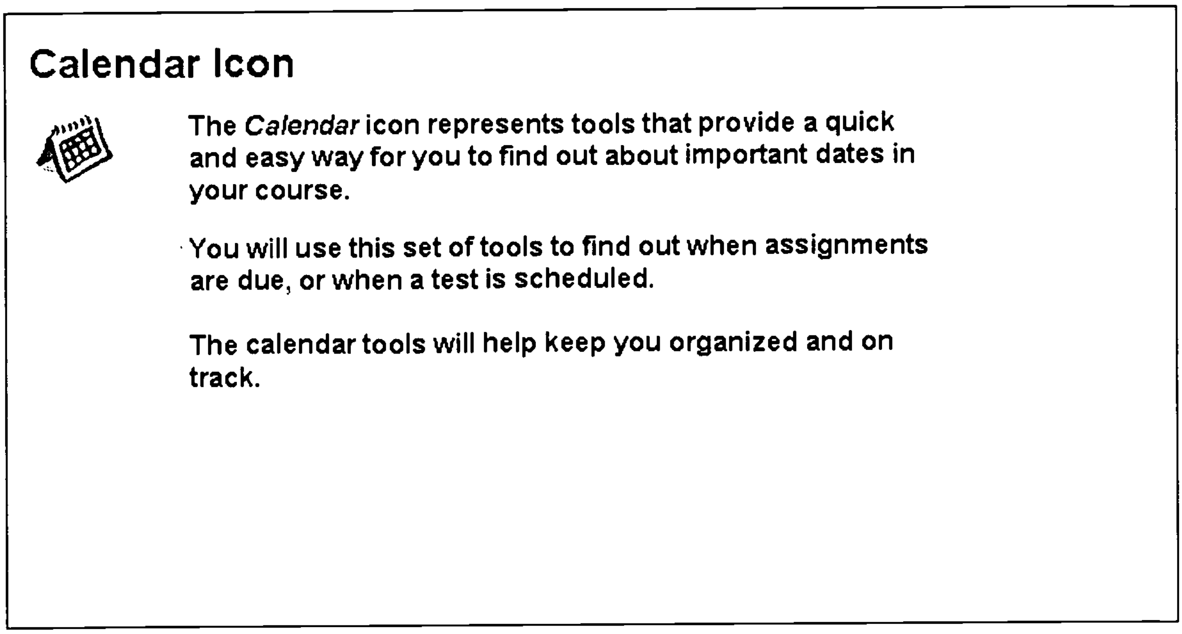

Figure 2. Sample Icon Screen

After working through the Rookie Camp sections concentrating on the names and tools represented by each of the nine WebCT icons, the student is then directed to work through the practice section of the unit. The student is again reminded that he/she is responsible for knowing the name of each icon and the tools each icon represents. The practice section consists of 18 multiple-choice type questions. For all of the questions, a graphic of one of the nine icons is shown. In nine questions, the student is asked to select the name of the icon from the responses provided, and in nine more questions the student is asked to select the tools represented by the icon from the responses provided.

When student has completed the practice section, he/she is told that the Rookie Camp Cheer can help in remembering the names of the icon. The student is then asked to come up with their own strategy for remembering the tools the icon represents. This is the review section of the unit. (In the final version of the unit, the student may be reminded that he/she can go back through the unit to review any of the icons they may have had difficulty learning. The student can go back to any section by clicking on the "pg back" button or by clicking on the hyperlink of the section displayed on the left side of the WebCT screen. This information is not provided in the prototype unit. Due to time constraints in the formative evaluation or try-out process, it was best for students to work through the unit in a linear fashion.)

The unit is then concluded. The student is then directed to complete the unit quiz and attitude survey. For purposes of the formative evaluation, a paper-based quiz was used. In order to program a quiz in the WebCT format, it is necessary to "attach" the quiz to information in a student database. This information was not available during the development of the unit.

Formative Evaluation of the Unit

Procedure

During the Spring 2000 semester, a formative evaluation of the Rookie Camp unit took place at the high school. The formative evaluation consisted of having students work through the entire unit and complete the unit assessment and attitude survey. The try-out was conducted in a Freshman English class. The teacher was beginning to develop activities in WebCT for her class, so was very interested in conducting the try-out with her students. The classroom was equipped with six computers with Internet access, so the teacher selected six students to participate in the tryout. Of the six students, three were considered "high-achievers" and three were considered "low-achievers". All students were ninth graders.

When I arrived at the classroom I accessed the Rookie Camp unit from each of the six computers. There were three computers on one side of the room and three on the other side of the room. The teacher was conducting class while I was readying the computers. Once the computers were ready, each of the students sat down at a computer. I gave them each a Rookie Camp User Guide and Rookie Camp Reminder Card. They were asked to read the User Guide and begin working. The Rookie Camp User Guide stated that Rookie Camp is a unit of instruction focusing on the nine "default" WebCT course homepage icons. In Rookie Camp they would be introduced to the names of each icon and the tools each icon represents. Since the unit covers a lot of material, it was suggested they take notes on the Rookie Camp Reminder Card. They were to work through the unit in its entirety making sure to read each screen carefully.

Unit Assessment Results

The unit assessment was a paper-based instrument, as indicated earlier. There were nine sections with each section showing a graphic of one of the nine WebCT homepage icons. In the space next to the icon, the students were directed to write in the name of the icon, and describe the tools the icon represents.

Overall, students did well on the assessment. For all nine icons, all six students were able to provide the correct names of the icons, the first learning goal. Describing the tools the icon represents was slightly more challenging. The student's scores for this learning goal averaged 67% correct. In fact, one student did not provide a description for any of the tools of the nine icons; it is not clear if they did not understand the directions, did not remember any tool descriptions, or ran out of time - the change of class bell rang while some students were still completing the assessment.

Attitude Survey Results

The attitude survey consisted of 10 4-item Likert type statements, and two open-ended questions. Summary of the Likert statements indicated that all six students agreed that the unit directions were clear, the unit was about the right length, they enjoyed the unit and would recommend it to their classmates.

The first open-ended question asked the students what they really liked about the Rookie Camp unit. Student responses included the directions being clear and the unit being simple and easy to use.

The second open-ended question asked students what would improve the Rookie Camp unit. The students suggested using more pictures and color. This is very interesting since there are pictures and/or color on all screens. One student indicated that there was too much content, while one student even stated that the unit was perfect!

In general, it appears that the students enjoyed working through the unit. For the most part, they were successful at learning the names of the icons, but still need additional instruction and practice in order to learn the tools represented by the icons. A revision to the unit should possibly include providing the student with practice activities using the icons and related management tools to complete various tasks.

Implications for Learner Support

The Rookie Camp unit in WebCT provides students with an introduction to the elements with which they will be working in a web-supplemented learning environment. Ease of use is critical to promoting success in computer-assisted instruction. If the students continually need help in overcoming obstacles in the software, they will become frustrated quickly (Heinich, Molenda, Russell, & Smaldino, 1998). Based on these concerns, students using web-based instruction should become familiar with the navigational requirements of the system being used, as well as suggested study skills to enhance their success.

Additional Implications

In addition to becoming familiar with the computer as a new learning tool, student success is also predicated on the use of successful study skills and learning strategies. Students participating in distance education courses have stated that improving study skills is a key element (Visser & Visser, 2000). The skills that students need in order to succeed in all forms of instruction, especially individual instruction, play an important role in effective learning in computer-assisted instruction. Some of these skills include planning and organizing for learning, and learning to apply skills developed in the classroom or paper-and-pencil environment to complete computer-assisted instruction (Cates, 1991).

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Strategies for Creating and Supporting a Community of Learners
In the Instructional Systems Technology Distance Master's Program at Indiana University (Core Courses R511 and R521/522)

Melanie Misanchuk
Tiffany Anderson
Joni Craner, Pam Eddy
Carol L. Smith
Indiana University

Abstract

This paper presents strategies and rationales for implementing certain instructional techniques to move a class from cohort to community. The context is the new Distance Master's program in Instructional Systems Technology at Indiana University. The authors give suggestions for instructional and non-instructional strategies that have students interacting at the levels of discussion, cooperation and collaboration. These strategies are cross-indicated with their intended outcomes, that is, strengthening the feeling of community as defined by a set of characteristics, which are adapted from Schwier (in press). Suggestions for evaluation techniques are also presented, as are questions for further research.

Introduction

The shift from traditional classroom education to computer-mediated distance learning poses enormous challenges to instructors and learners. The concept of the classroom where students meet to interact with other learners and the instructor no longer exists. The instructor can no longer "look" around the room to see if students are attending to the material, bored or confused. Learners lack a natural social outlet to engage with other learners thus leading to feelings of isolation. The learner is now engaged with the computer instead of other learners. The big question for our project is "How do we structure the course design so learners have mechanisms to connect with each other and form community." How do we overcome the characteristics of the medium so that learners feel connected to the instructor and other learners?

The literature on effective teaching and learning promotes several "big ideas" that we used as foundations for our recommendations. These include Vygotsky's (1978) social development theory and the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamson, 1987). Vygotsky's social development theory states that social interaction is vital to cognitive development; all higher-order functions originate as the relationships among individuals. To scaffold learning we must require learners to interact with the content, the teacher and each other. Our strategies focus on promoting communication, social interaction and participation. Many of the principles, theories and strategies we encountered reflect the Seven Principles of Good Practice in Undergraduate education (Chickering & Gamson, 1987). At their core, each of the seven principles focuses on interaction. In 1996, Moore and Kearsley described three types of interactions that are necessary in distance education: learner to learner, leaner to content and learner to instructor. We would argue that these three types of interaction are necessary in education regardless of where or how it takes place.

Characteristics of Community

There is much discussion of learning communities, communities of practices, and virtual or online (social) communities. Although each type of community has its distinct characteristics and requirements, there are many things they share in common. What we are endeavoring to create will be a combination of all of the aforementioned communities: a community of practice (since our cohort will be from the same company) that is involved in mutual learning online. Because of these special characteristics, some things do not apply. For example, there is much talk in the virtual community literature about attracting members and defining the community based on common interests. In our case, this cohort is thrown together and "forced" to form community. Outside members are not encouraged to participate, mainly because the common interest in this case is "taking the Distance Masters in IST from IUB." In a terrestrial community of practice, members might see each other at work, or meet in person once a week to deal with issues in their work lives. This will not exactly be the case for our community; although they will probably have some work issues in common, they are not a group of "teachers" or "nurses" or "engineers" who share vast amounts of experience and knowledge. Unlike an informal learning community, which spins itself from nothing and is based on a variety of people coming together for informal learning purposes and where the direction of both the learning and the community is malleable, our learning community will exist within strict parameters of this coursework. Obviously, members will be encouraged to bring other experiences and knowledge to bear on their coursework, but at the end of the day, the learning in question will be much more restricted than an informal learning community.

Selznik (1996) identifies seven elements of community: *history, identity, mutuality, plurality, autonomy, participation,* and *integration*. With respect to virtual learning communities, Schwier (in press) adds: an *orientation to the future, technology,* and *learning*. Some of these characteristics of community will be present from the beginning. Others, the cohort will have to grow into. We will describe the features of these 10 characteristics, and discuss how we will use them for our purposes.

Selznik notes that communities are stronger when their members share history and culture, rather than simply abstract general interests. Unlike an established terrestrial community, the nascent community forming from the distance education masters program will not have a shared *history*. Their history, like their identity, will have to grow and develop through their interactions with each other.

We believe that a shared sense of *identity* will develop in this cohort, and will strengthen their communal identity. Schwier's suggested strategies for fostering identity include team-building exercises, developing community logos, and public acknowledgement of individual and group accomplishments within the community. He also notes the importance of articulating the "focus or purpose of the community" and outlining the requirements and rituals. The structure of the courses allows for frequent and obvious reiteration of community focus, and events such as orientation can help the group define its own rituals and norms.

The very fundamentals of a learning community require interdependence and reciprocity, what Selznik terms *mutuality*. Since our focus is on cooperative and collaborative learning, this mutuality will develop naturally. Schwier also recommends asking "leading questions that encourage members of the community to invest in concerns held by other members, and to share ideas and possible solutions" (p. 5). This type of interaction can be encouraged at course-level in the class forum, and on a social level in the Online Café.

We combined Selznik's terms *history, mutuality,* and *identity* into a larger category called *group identity*. By combining these three concepts we emphasize the fundamental importance of group identity in fostering community. Although one of our goals in the next few semesters is to help students begin to construct a history relevant to their community, this is not something that can be imposed upon the group from outside. It has to grow from the sharing of each individual's history and the links that the learners form with each other based on their experiences. These links are characterized by interdependence and reciprocity, in other words mutuality. Group identity results from this history and mutuality, and from making the budding community history public and available to all, especially newcomers.

Plurality, according to Selznik, results when many different types of interactions amongst members of a community occur, often rooted by individuals' membership in other communities (work, neighborhood, church, etc.) that intersect. We replaced *plurality* with *social interaction*. Given a virtual community, one that to some extent is externally imposed, the opportunities for plurality are limited compared to those available to geographic communities. By providing opportunity for and the expectation of social interaction among participants, we purport the program will provide the plurality needed.

Autonomy of individual members within the community, especially within an academic setting, is important to foster. We will encourage thoughtful, personal postings within the forum, to avoid group-think

and "me too, I agree" contributions. Students will receive basic instruction on netiquette and will be encouraged to continually address evolving group norms to maintain respectful communication and to build consensus. We use *individual identity* in place of *autonomy* to underscore the importance of both group and individual identities within a virtual learning environment.

In the case of a virtual community, *participation*, both social and academic, is integral. Without active participation in discussions and other class activities, the learner is not part of the community; indeed, the learner does not even "exist." This is one core distinction between being a passive member of a physical community where you are seen and your presence is noted and registered in the minds of others. In a virtual community, you must make a concerted effort to communicate with others in order to exist. At the same time, allowances must be made for learners to shape the participation, both in structure (number/kind of postings) and in content (managing the discussion of subjects interesting to them).

The *future orientation* of a learning community can operate at a number of different levels. A stronger community bond will be formed when a particular cohort goes through a number of courses together, moving toward their finishing the program and earning a degree. It can be argued that a learning community can develop within the constraints of a single four-month course, but it is much more likely that students will form long-lasting academic and social bonds throughout an entire program. Visioning exercises and direction of learning activities (having participants describe how what they learned will help them in future learning and in their work) can also give the community a focus on the future. In our case, the community's view of the future may be limited to the two or three years they spend in the program. However, it is possible that they will continue to maintain community ties once they have earned they degrees and are working again. It is also possible that members of the Fall 2000 community would end up wanting to remain part of the Distance Masters community after they graduate, and would like to integrate themselves with the new incoming cohorts. This may pose particular problems of negotiation and fit; is there a role for graduated members to "return" virtually and engage with students working through the program?

Schwier notes that "the *nature of the learning* can be broadly defined and contextual"(p. 4) but is a necessary part of a virtual learning community. For our purposes, the learning involved is more specific and structured; the cohort moves through a set of core courses together, in a particular order. Our goal is to foster community among them before they finish the first year, so that although they will go on to take other courses with other distance learners, they will not only maintain ties with their initial cohort community, but will also have learned the foundations of virtual community creation and will use these skills in other classes. We have changed Schwier's term *learning* to *knowledge generation*.

According to Schwier, "communities are built or dismantled by those in the communities, not by the people organizing or managing them" (p. 2). As they mature, communities define their own social rules of conduct and select their own leaders, assuming *ownership* of their governance and norms. Learning communities, note Palloff and Pratt (1999), exhibit evidence of socially constructed meaning, willingness to critically evaluate the work of others, again assuming ownership of their knowledge creation and sharing.

Integration of all of these elements is necessary for a strong community. Schwier suggests creating belief statements and evolving group norms, and adhering to a learner-centered philosophy that "supports individual expression while building a group identity" (p. 5).

Finally, *technology* is an important consideration for us: although it is thanks to certain technologies that virtual community-building is even possible, there are certain limitations put upon the group because of technology. Although it is the conduit for discourse, it can also exclude or discourage people. Tools that are complicated, unavailable for a certain platform, that are slow and cumbersome can all render the discussion process less than ideal, and members who do not actively participate essentially leave the community. Although Schwier recommends using technology compatible with older, less costly equipment to render the community more inclusive, this is not a concern for us.

Based on Selznik's (1996) seven characteristics and Schwier's (in press) additional three characteristics of community, we have assembled the aforementioned six key elements of community. From these elements, we define community as: a group of people who are brought together to share and generate knowledge in a mutually supportive and reciprocal manner. Its characteristics are ownership, social interaction, group identity, individual identity, participation, and knowledge generation. Furthermore, integration of all of these elements is necessary for a strong community.

Having defined some of the particular characteristics of a virtual community, we will now turn to some basic strategies for creating community. Palloff and Pratt (1999) recommend these steps:

- Clearly define the purpose of the group

- Create a distinctive gathering place for the group
- Promote effective leadership from within.
- Define norms and a clear code of conduct.
- Allow for a range of member roles.
- Allow for and facilitate subgroups.
- Allow members to resolve their own disputes (p. 24)

In our case, many of these steps are automatic, but they should still be given careful consideration. For example, the general purpose of the community is defined as "the Fall 2000 cohort for the IST Distance Masters program." However, instructors or organizers may have more specific goals and purposes from the beginning, and even if they do not, other purposes may emerge from the community throughout the term. Pallof and Pratt (1999), surprisingly, do not put much emphasis on the communicative aspect of community without which a virtual learning community cannot exist.

We feel that one of the most important indicators of a learning community is the first: when students communicate not only on an academic level but on a personal level. Working together towards the goals of the course is what they are "supposed" to be doing. When they begin to talk about their personal lives (families, hobbies, jobs), their triumphs and trials with being a distance student (scheduling, technical problems, disagreement with pedagogy), when they seek each other's counsel for other areas of their life (job change, which elective course to take next, family issues), this is the point at which we feel they are comfortable as a community. There is a good chance that not everyone will be everyone else's best friend. However, when a majority of the members feel they are in a safe enough space to "speak up" about things in the public forum, rather than in individual e-mail messages, then this is evidence of a successful community. There may be a few members of the community who do not feel that the Online Café is an appropriate place to discuss non-academic subjects, and it is the role of the mentor and the community members to make the Café a welcoming place for this type of discussion. As in every type of community, there will be some people who opt out of certain discussions, or even out of all "non-official" discussion, but this is quite normal. There will probably be smaller communities within the larger online class, people who form bonds and discuss the course work and their lives, but not on the general forum. These differences can appear for a variety of reasons; Eastmond (1995) found divisions on age, gender, experience, and learning style lines. However, he also found that the groups often transcended age and gender, for example, two characteristics that might, in a traditional classroom, be impediments.

The final step in creation of an online community is to evaluate whether a community has formed, and if so, in what ways has the community aspect contributed to learning. Our project will address methods for performing the first evaluation of whether community has formed.

Definitions

We will examine ways to use certain instructional strategies to work to move the cohort toward a community. We suggest encouraging interaction at three levels: discussion, cooperation, and collaboration.

Cohort

The cohort is the group of students going through the core classes as a group. They may have an initial connection, such as a common employer, but it does not necessarily constitute a strong bond.

Discussion

Discussion is the basic means of communication in an online format. Students must participate in discussion to have any sort of presence in the class whatsoever. Discussion can be focused around readings, lectures, and any other ideas based on course content or course administration. Discussion can occur asynchronously in the SSF or via e-mail, or synchronously via chat rooms or telephone.

Cooperation

Cooperation entails students working in groups or otherwise dividing up tasks. A machine metaphor can illustrate cooperation in the classroom: different parts of the machine perform different functions and goals, but work together towards a similar end. For example, students may divide up a project, but are eventually assigned individual grades for their work. Examples of cooperative tasks include: dividing up sections of a report to write and doing peer review of each other's work.

Collaboration

Collaboration is the most integrated form of group work, and is therefore potentially the most difficult and the most rewarding. In the case of collaboration, the group members work toward a common goal, one that carries a mutual investment. For example, students may each work on every part of the

report, consulting each other and re-reading each other's edits. They are invested in every part of the project because they will share a common grade. Examples of collaborative tasks include group writing and creating an ID model.

Community

A virtual learning community, as described in the introduction, is one of the ultimate goals of the core courses.

The three levels of interactions can be compared by several characteristics, as in the table below.

	Discussion	Cooperation	Collaboration
Learning	Information transmission	Knowledge transmission	Knowledge generation
Inquiry	Individual inquiry	Delegation of tasks	Common inquiry
Decision-making	Agree to disagree	Vote (majority rules)	Social negotiation to consensus
Goals/agendas	Multiple goals/ multiple agendas	One goal/ multiple agendas	One goal/ one agenda
Accountability	Individual accountability	Individual accountability	Group accountability
Learning relationship	Complete independence	Partial interdependence	Complete interdependence

Description of IST Core

The term "Core" is used in the IST department to denote four courses that all graduate students take in their first year in the program. Traditionally R511 (2 credits), R521/522 (4 credits), R580 (1 credit) are offered in the Fall term; R561 (3 credits) is offered in the Spring. It is usually the case that the new students (both Masters and Doctoral) take these classes as a group; they form a cohort that goes through at least the first year of courses together. The cohort identity is important to the IST program, and it is something that will be actively cultivated in the online Masters program. Tangential to the cohort identity is the community-building that is undertaken to integrate new students into the IST program. The social aspect of the community is nurtured through happy hours, the IST picnic in the fall and the Follies show in the spring, and informal pairing new students with old ones. Academically, the IST community is built through the identity of the Rookie cohort, through the rookies taking non-Core classes (R547, Y520, etc.) with upper year students, through rookie interaction with upper year AIs in Core and non-Core classes, etc. The IST department is also very much linked to its alumni, through alumni presentations in R580 (Grads with Gigs) and networking at conferences.

The pedagogy is rooted in project-based learning and team-based work. Much of the learning is hands-on, and students often work with real-world clients. There is a focus on an integrated curriculum and many of the courses are team-taught. The different research areas of the faculty (for e.g., corporate vs. higher education vs. K-12) expose all students to multiple academic perspectives. The international nature of the program (approximately one-third of the students are non-U.S. citizens) exposes all students to different ways of learning and working. Because of the content, there is an emphasis on technological competence, although the skill levels of both entering and graduating students vary immensely. Although the use of technology in education is important to IST, technology is a means, not an end, and its use is firmly rooted in pedagogy.

The associations that IST has with other departments, including Educational Psychology, Language Education, the Kelly School of Business, the School of Library Science, etc., contribute to an integrated and interdisciplinary academic environment. Most of these departments offer online courses that can be used by Distance Masters students as electives.

Core Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Participatio*	**Strategies**	**Rationale**
✓		✓	✓	✓	✓	Students participate in a face-to-face orientation on campus.	Face-to-face interactions allow to people to create strong initial bonds, which will lead to

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Participatio	Strategies	Rationale
							a greater sense of community right from the beginning.
✓	✓			✓	✓	Students will learn about online communication, including rules of netiquette	Online communication is vastly different from more traditional forms of communications (Black, 1995).
	✓			✓	✓	Students will undergo training in using SiteScape Forum, e-mail, majordomo creation, basic web searches, and MS Word for collaborative writing purposes.	To help reduce barriers to effective learning and establishing social relationships, participants should be given the opportunity to build confidence and competence with the distance education process and supporting technologies (IDE, 2.2).
		✓	✓	✓		Students will post photos of in SiteScape Forum at Orientation.	Connecting people's names and faces is a first big step to forming bonds.
✓	✓		✓	✓	✓	Students will participate in a content-based group project that requires that they negotiate the exact content.	People will form strong personal and academic bonds through shared adversity (Ruhleder, 1999).
			✓	✓		Students will be required to eat lunch as a group two days during Orientation.	People who have a social connection to the group will work better together (Palloff & Pratt, 1999).
			✓	✓		Students will be given the opportunity to participate in at least two evening social activities.	People who have a social connection to the group will work better together (Palloff & Pratt, 1999)
		✓			✓	First posting should be a non-graded/non-credited assignment (e.g. biography).	Students need non-threatening, interesting ways to begin creating online community (Funaro, 1999).
✓	✓	✓	✓	✓	✓	Create an online café that will serve as a non-course-specific conversation area to encourage off-task communication.	People need distinctions between work and play (Palloff & Pratt, 1999).
		✓	✓	✓	✓	Encourage instructor and distance mentors to participate in social interactions, especially in the early stages of the course.	Social interactions between and among learners enrich the learning community and should be supported in the instructional design of the course (IDE, 2.5).
		✓	✓	✓	✓	Students will be encouraged to share, in the online café, information about their non-academic lives, for example, offering mutual support in term of how they are keeping up with their job and school schedule. Students should be encouraged to offer successful strategies to the class.	Reciprocity and help are two important hallmarks of community. Students who take an interest in each other's well being, both academic and social, will have more of a support system of peers than those who do not (Wellman & Gulia, 1999).

R511 Section

Description of R511 (from course syllabus)

R511, Instructional Technology Foundations I, is a two-credit course that has historically been offered each fall semester. This course is required by all IST Masters students and is typically taken

concurrently with R521/522, Instructional Design and Development, and R580, IST Colloquium. It is team-taught by two faculty members and one graduate assistant who has taken the course.

The overall objective of this course is to provide a comprehensive introduction to the field and profession of Instructional Technology (IT). Since most entering IST students come from fields other than instructional technology, R511 gives newcomers a sense of history and an explanation of how the components of the field fit together. There is a particular emphasis on the evolution of the "big ideas" of the field.

In the onsite version of R511, class meetings occur once per week in 2-hour sessions. Directed readings compiled in a course packet are provided as practical resources to support assignments and class discussion activities in the course. Most class periods are divided into two portions: 1) During the first hour, each of the three instructors facilitates a group discussion among 15-20 students about assigned readings. 2) The remaining portion of the class time is devoted to further lecture and clarification about topics contained in the readings.

Students are graded according to participation in class discussion, personal synthesis and reflection (as noted in weekly minute-papers collected at the end of each class), three individual written essays (one team-based, two individual), and a final exam or written essay.

R511 Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Participatio	Strategies	Rationale
					✓	A fundamental element for success for the distance students is an understanding of the key expectations - how much time the course will require - the level of performance that is expected of them - the demands that participating in the core will have on their time.	Students, but especially students learning at a distance, need to have expectations, assumptions, deadlines, etc., made explicit and kept clear (Palloff & Pratt, 1999). Understanding and respecting expectations for participation and performance will be critical to the students' success. Taking Core online will be more demanding than doing it face-to-face.
	✓	✓		✓	✓	Instructors will assign discussion roles (facilitator, summarizer, devil's advocate, etc.) to encourage shy members and force students to think in different ways about the material and about the discussion of the material.	Students should be challenged to engage the material from different perspectives; different roles improve learner-learner interaction and improve learner-material interaction.
	✓		✓		✓	Students will be expected to take part in regular peer reviews by critically evaluating each other's papers.	It is important to develop a critical eye towards other community members' work.
✓	✓				✓	Each week, someone from each group will summarize their group's discussion and post the results for the other groups to read.	Bringing from small groups to the larger group provides for more viewpoints and better discussion.
	✓		✓		✓	Students will be divided into 3-4 small groups for discussion of readings and course projects.	Small groups facilitate better discussion (Hiltz, 1998) for learner-material interaction.
✓		✓			✓	Students will fill out weekly "1-minute evaluation" web form, to instructor only. Possible topics include what you liked/disliked about the week's work, how you can transfer	To better assimilate and process what they have learned, students require a forum to critically reflect on the material and on themselves as learners (Palloff & Pratt, 1999). Keeping in touch with the

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	Participatio	**Strategies**	**Rationale**
						this knowledge to your work, and generally how you are feeling.	professor improves learner-faculty interaction.
	✓		✓		✓	Instructors will require high-quality online interactions with peers and discussions of readings by making a portion of the grade dependent on it. (We recommend at least 25%).	Effective learning environments should provide frequent and meaningful interactions among learners. (IDE, 2.1) Good practice encourages cooperation among students (Chickering & Gamson, 1987).
	✓			✓	✓	Instructor and/or mentor will model ways to produce lively, constructive discussion: questions should be open-ended, but focused on students' interpretation of the text.	One of the best ways to keep discussion on topic and students motivated is to participate actively in the conversation (Beaudin 1999).
✓	✓	✓			✓	Instructor will point out excellent discussion, postings, interactions, etc. of other students to continually promote high expectations and model good interaction.	Good practice encourages prompt feedback (Chickering & Gamson, 1987). Faculty-learner interaction improved by attentive professor.
✓			✓	✓		As needed, instructor will revisit netiquette and general interaction issues, and stresses the importance of interacting in a respectful way. Have the community develop group norms based on emergent issues.	Social negotiation leads to the creation of a safe space, which is essential for learning (Palloff & Pratt, 1999).
					✓	Students will be expected to check SiteScape Forum and e-mail every two days and post quality contributions at least twice a week. Participation points will be calculated based on these postings.	Because of the nature of the evolving discussion, students should be constantly engaged in the course, without any lengthy absences from discussion. (Caldwell & Taha, 1993)
✓		✓	✓		✓	The instructor/AI should make contact with students who are not actively participating to find out why and address their concerns.	Students need to actively feel like they're part of the community, and that the instructor is interested in their well-being, academic or otherwise (Palloff & Pratt, 1999).
	✓		✓		✓	Students will work together at all three levels of interaction: - Discussion - Cooperation - Collaboration	In order for a newly-formed cohort to move to community, they must change the quality of their interactions. The community should move toward successful use of collaboration, in addition to the continued use of group discussions and cooperative tasks.

R511 Assignment Specifications

Based on the existing assignments for R511, we have developed a set of projects and assignments that will both address the traditional content of the course, and build community based on the discussion, cooperation, and collaboration model. Where we realize that collaboration is a more rich form of thinking and working together, we also emphasize the necessity for students to work at all three levels of interaction throughout the course.

Discussion

- At the beginning of the semester, students will be divided into readings discussion groups of 3-4 people. For purposes of community and continuity, they will remain in these groups throughout the semester.
- In SiteScape Forum, a team will be created for each readings discussion group. The group will manage that space, and can create folders for each week's readings if they so choose.
- The students will be expected to discuss the week's readings in their respective folders. Each student should post at least twice each week.
- The role of facilitator in each discussion group will rotate from week to week. The facilitator must start the conversation, and engage group members to participate.
- The role of summarizer in each discussion group will rotate from week to week. At the end of the week, the summarizer must condense the group's main discussion points, and post them to the class forum (outside the team space).
- There will be a separate folder in SiteScape Forum for discussion of the week's lecture or class activity. These posting requirements will be determined at a later time, dependent on the format of the course lecture material.

Cooperation

"Letter Home" Paper

Students will review each other's papers in formative stages. For the "letter home" assignment, students will post outlines and rough drafts by set deadlines, and a selected group of peers (ideally from outside their reading group) will have to read and give feedback on them. The rationale for a number of small deliverables leading to the final paper is that distance students traditionally need regular deadlines and prompt feedback.

Final Exam Study Guide

Students can still help each other out on breaking down the study guide and elaborating on certain sections of it. This could be left open for students to determine, just as in the traditional R511 class. Simply make the suggestion to the students that they may want to work together on fleshing out the study guide, and leave it to them to decide how they want to do it.

Collaboration

ID Model Paper

The students will collaborate on the ID model paper as in the traditional R511 class (using their reading discussion teams as the groups). In the distance version, however, it will be critical that this process be divided into small deliverables. For instance, the students might be required to break down the task into the following deadlines:

- *Week One:* Each group member must post initial ideas of possible models to evaluate or create. This is not in any formal structure – just a brain dump. Each group member must read and respond to the discussion.
- *Week Two:* Group must decide on a model and begin explicating the model and describing its strengths/weaknesses. All group members should be posting during this week.
- *Week Three:* Someone in the group should summarize the discussion into a paper outline. Another group member should develop a paper draft. One or two group members should make suggested changes and revisions. The final group member should write the final draft and post it.

"ism" Debate

Students will participate in group debates revolving around behaviorism, cognitivism, and constructivism. Ideally, students will be placed into 3 groups that are different from their reading groups. Each group will be assigned one of the "isms" to represent in the debate. Here, a proposed timeline for the debate:

- *Week One:* Individuals will write an informal short paper (one page – perhaps even as a bulleted list) highlighting the major strengths of their "ism" as it applies to distance education courses and will post it for their teammates. Next, the team will enumerate possible rebuttals from the other groups and responses to those arguments. The first week's discussion and postings will all take place inside a new folder established for that team.
- *Week Two:* One student from each group will post an argument about why their position is the best to a debate folder open to the whole class. Each group will respond to each of the other groups.

- *Week Three:* Debate will continue.
- *Week Four:* Each individual will write a brief reflection on how their opinion changed throughout the debate.

Checklist for R511 Instructor/Mentor

Orientation

- ☐ Attend Sunday night dinner with new DE students.
- ☐ Participate in 2-hour R511 class welcome session.

Beginning of Semester

- ☐ Create teams in SiteScape Forum for each readings discussion group. Using a naming structure like jewels (Opal team, Ruby team, etc.) is an easy identifying factor.
  - Divide students into the groups evenly. Make sure the instructor and GA are listed as members of all teams.
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled "R511 Lecture and Class Activity Discussion."
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled "R511 Resources & Tidbits"
- ☐ Create a class majordomo.

Weekly

- ☐ Check that all class members have posted at least twice about the readings.
  - If not, make decision about contacting that person via e-mail.
- ☐ Check that all class members have posted about the lecture/class activity.
  - If not, make decision about contacting that person via e-mail.
- ☐ Post some comments to the Online Café. This could be
  - News stories
  - Responses to other students
  - Encouragement
  - Personal comments
  - IST/DE news
- ☐ Reply to at least 2 postings a week, to encourage students to post thoughtful responses and to show that you are present and actively following the discussions.

Before the "ism" Project

- ☐ In SiteScape Forum, create the following three teams: Behaviorism, Cognitivism, and Constructivism.
  - Divide students equally among the three teams. Make sure the instructor and GA are listed as members of all teams.

Before the "Letter Home" Paper

- ☐ In SiteScape Forum, create the following five teams: Peer Review Group 1, Peer Review Group 2, Peer Review Group 3, Peer Review Group 4, and Peer Review Group 5.
  - Divide students equally among the five teams. Make sure the instructor and GA are listed as members of all teams.

R521/522 Section

Description of R521/522 (from course syllabus)

R521/522, Instructional Design and Development, is a four-credit course that has historically been offered each fall semester in an onsite format. This course is required by all IST MS students and is typically taken concurrently with R511, Instructional Technology Foundations I, and R580, IST Colloquium. It is team-taught by at least two faculty members and one or two graduate assistants who have taken the course themselves.

Major content and experience objectives of R521/522:

- Knowledge of instructional design principles
- Knowledge and application of the ADDIE model of instructional design and development

- Understanding and application of simple formative evaluation processes
- Ability to recognize and employ fundamental principles and experiences in team-based approach to project work

Pedagogical methods used in R521/522:

- Task-oriented learning through "authentic" projects
- Diverse, team-based project groups
- Mentor/coach-based instruction for project team support
- Structured timeline of deadlines and deliverables
- Independent learning, i.e., students take responsibility for their own learning
- Assignments with specific criteria that engage students in learning specific course content, with leeway given for students to identify their own topics

Most of the learning in the course occurs within the context of projects and situations similar to those that instructional designers encounter in professional work. Projects are sequenced such that the processes and principles learned in the first ones provide foundation of understanding and competence for progressively more complex ones that follow. This progression of increasingly elaborated projects continues through the academic year into R561, Evaluation and Change Management, and is intended to carry on throughout the student's academic experiences in completing the IST MS program.

In the onsite version of R521/522, class meetings occur twice per week in 2.5 -hour sessions. Class sessions involve one or more of a variety of activities, including lectures or presentations about specific topics, readings discussions, project group meeting time, group project presentation, or hands-on design activities. Directed readings compiled in a course packet are referenced as practical resources to support projects and class discussion activities in the course.

The instructors believe that people learn best when they are highly motivated and actively engaged in learning tasks, that learning is most useful when it is directly related to learner needs. Thus, students are expected to take responsibility for their own learning. The course begins with a fair amount of guidance from the instructors, in terms of what information to access and how to facilitate personal learning, then gradually decreases that guidance to require students to actively seek resources on their own to perform the assigned tasks.

Major projects in R521/522 are completed by groups of three students, each mentored by an assigned instructor "coach." To perform most satisfactorily in the course, students must spend many hours per week outside of class developing and completing these projects. At the completion of a project, each member of a given group is awarded the same grade (a "group grade") as his/her teammates. Approximately twenty percent of that grade is awarded for the deliverable produced in the project (e.g., the instructional tool developed and a design report), whereas the remaining portion of the grade is awarded according to the way members worked within the team setting. Some students come into the program with extensive background in true teamwork, but most do not. Thus, the instructors devote a portion of instructional time early in the semester toward preparing students for the team experience. Throughout the duration of each project, group coaches continue to offer advice and guidance for the team process.

R521/522 Instructional Strategies and Rationales

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Participatio*	**Strategies**	**Rationale**
	✓					Learners will be divided into 3-4 groups for discussion of readings and course projects.	Small groups facilitate better discussion. (Hiltz, 1998)
✓	✓		✓		✓	Provide criteria that define appropriate course topics, leaving room for choice and opportunities to leverage work-related projects as course projects. • Learners select a topic and procedure for project. • Each team selects 4 readings to	In order to build community, learners need ownership. (Schwier, in press)

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Participatio*	**Strategies**	**Rationale**
						read and summarize for the whole class (for discussion)	
✓	✓				✓	Each week, someone from each group will summarize their group's discussion and post the results for the other groups to read.	Bringing from small groups to the larger group provides for more viewpoints and better discussion.
	✓		✓		✓	Students will be divided into 3-4 small groups for discussion of readings and course projects.	Small groups facilitate better discussion (Hiltz, 1998) for learner-material interaction.
	✓		✓		✓	Instructional activities will require the learner to actively participate in the acquisition and processing of educational content. • Team-based authentic projects where the learners learn by doing. • Discussing readings online and role-playing. • Require high-quality online interactions with peers and discussions of readings by making a portions of the grade dependent on it (25% recommended) • Groups will be responsible for posting some of their work in progress (e.g., each group posts a description of a different aspect of ADDIE). • Instructor should use open-ended questions to encourage dialogue. • Ask learners to provide URLs that enhance learning.	To better assimilate and process what they have learned, students require a forum to critically reflect on the material and on themselves as learners (Palloff & Pratt, 1999). Keeping in touch with the professor improves learner-faculty interaction.
	✓				✓	Instructor will phone each learner before class begins. (Spear & Bruce, 1997)	One-on-one verbal communication between learner and instructor solidifies relationship.
	✓				✓	Establish a virtual office hour: one hour where instructor will be available for online chats, office phone calls, or e-mail. Inform learners of the faculty member's expected e-mail or voicemail response time, e.g., within 24 hours, twice a week, etc. (Spear & Bruce, 1997) (Spear & Bruce, 1997)	Students like to know the professor is available at a particular time to address e-mail concerns.
				✓	✓	Instructor will be proactive, following up on the learner who is not participating in chats, discussions, etc.	In the distance format, it is easy for students to lose touch with the class and slowly drop out. Active intervention from the instructor can lessen attriction.
✓	✓		✓	✓		Conduct a phone conference with each team at least once during the	Verbal communication between the team and instructor solidifies relationship and

Ownership	Know. Gen.	Ind. Identity	Shared Iden.	Social Inter.	*Participatio*	**Strategies**	**Rationale**
						development of each project.	makes for easier clarification.
✓	✓				✓	Invite other professors to lead discussions (Davies and Reigeluth on concept learning) where learners can interact directly with experts to deepen understanding.	Students will appreciate input from experts in the field. The will feel less isolated from the rest of the department when they can interact with other instructors.

R521 Assignment Specifications

Based on the existing assignments for R521, we have developed a set of projects and assignments that will both address the traditional content of the course and build community based on the discussion, cooperation, and collaboration model. The students will collaborate on production projects, discuss readings or lecture topics, and reflect on activities and experiences throughout the course. While we realize that collaboration is the richest form of thinking and working together, we also emphasize the necessity for students to work at all three levels of interaction throughout the course.

Discussion

Readings

Discussion activities centered around the course's major themes (e.g., usability, design, evaluation).

- At the beginning of the semester, students will be divided into readings discussion groups of 5 people (different from those in their project groups). For purposes of community and continuity, they will remain in these groups throughout the semester.
- In SiteScape Forum, a team will be created for each readings discussion group. The group will manage that space, and can create folders for each week's readings if they so choose.
- The students will be expected to discuss the assigned readings in their respective folders. Each student should post at least twice each week.
- The role of facilitator in each discussion group will rotate from assignment to assignment. The facilitator must start the conversation, and engage group members to participate.
- The role of summarizer in each discussion group will rotate from assignment to assignment. At the end, the summarizer must condense the group's main discussion points, and post them to the class forum (outside the team space).

Cooperation

Group projects

- At the beginning of each project, students will be divided into groups of three. Each group will work collectively to complete its own project. A team "coach" (an instructor or graduate assistant) will be assigned to each group to offer advice and guidance for the team process.
- In SiteScape Forum, a team will be created for each project group (including the course instructors and mentors). The group will manage that space.
- Groups will be required to post all team meeting summaries and other artifacts of their team processes on the forum.

Collaboration

Group projects

- For each project, the team will be intentionally diverse in gender, nationality and/or job background as much as possible to encourage multiple points of view.
- Projects will be assigned group grades, a large portion of which is assigned to the "group process."
- Give project rubrics, teams will be encouraged to brainstorm possible topics and come to consensus to identify their own topics for projects.

- Teams will engage in formative peer reviews of each others' projects and materials for projects throughout the course.
- Lectures and course topics will be presented by different instructors throughout the course, providing a model of collaboration for students.

Checklist for R521 Instructor/Mentor

Orientation

- ☐ Attend Sunday night dinner with new DE students.
- ☐ Coordinate a team-based project that emulates the required peer interaction and interdependence and time-limited working tensions of R521 production projects.
- ☐ Post expectations (time, participation, assignments, dates)

Beginning of Semester

- ☐ Create teams in SiteScape Forum for each readings discussion group.
  - Divide students into the groups evenly. Make sure the instructor and GA are included as members of all teams.
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled "R521 Lecture and Class Activity Discussion."
- ☐ In SiteScape Forum, create a Discussion & Document Forum entitled "R521 Resources & Tidbits"
- ☐ Create a class majordomo listserv and direct all class members to subscribe to it.

Weekly

- ☐ Post some comments to the Online Café. This could be
  - News stories
  - Responses to other students
  - Encouragement
  - Personal comments
  - This week in IST
  - Post reflection questions each week

Beginning of Each Project

- ☐ Create teams in SiteScape Forum for each project group.
  - Divide students into the groups evenly. Make sure the instructor and GA are included as members of all teams.
- ☐ Direct each team to construct and post its own individualized strategies and timeline for conducting the team process and completing its project.

Throughout Project

- ☐ Check that each project team is posting evidence of cooperative work on project at least once per week.
  - If not, make decision about contacting that group via e-mail.
- ☐ Reply to at least 1 or 2 postings a week per group, to encourage students to post thoughtful responses and to show that you are present and actively following the discussions
- ☐ Check that all team members are participating at least once every two weeks within their own project teams

End of Project

- ☐ Review reflection essays from each team member about lessons learned from the production and team processes
- ☐ Collect peer grading of team members' participation within each team

Evaluation

The final step in the creation of a learning community in these courses is to evaluate whether such a community has formed and, if so, in what ways the community aspect has contributed to learning. We are

basing our strategies for evaluating the success of community-building in these courses on Palloff & Pratt's (1999) indicators that an online community has been forming:

- Active interaction involving both course content and personal communication.
- Collaborative learning evidenced by comments directed primarily student to student rather than student to instructor.
- Socially constructed meaning evidenced by agreement or questioning, with the intent to achieve agreement among students.
- Sharing of resources among students
- Expressions of support and encouragement exchanged between students, as well as willingness to critically evaluate the work of others. (p. 32)

The course evaluations will take two forms: Formative evaluations are undertaken throughout the course so that necessary adjustments in course delivery and activities can be identified and made. Summative evaluations are performed at the conclusion of the course to measure final learning outcomes and student satisfaction. Both forms provide fundamental indicators of the overall success of the course and its participants in meeting the initially stated objectives. Palloff & Pratt recommend employing evaluations over three distinct elements of a online course: student performance and learning, effectiveness of the course in supporting student learning objectives, and overall student experiences of the students in working in an online environment. For our purposes of assessing community formation, the emphasis on student performance is most the most important factor on which to focus.

We have stated already that two key indicators that the evolution of a community has occurred are evidence of participants accepting ownership of the community and realizing a shared identity. The metaphor of scaffolding activities and course strategies as mechanisms to foster community implies that the instructor provides models and activities to course members through which they exercise community-like tasks and interactions. These scaffolds are erected as temporary measures to support the desired behavioral outcomes until observed behavior indicates they are no longer used or needed, then they are gradually removed. Concurrently, formative evaluation that measures indicators of the extent to which online community is occurring becomes the key factor in determining the necessity and lifespan of each scaffolding device.

Suggested methods for formatively assessing the level of online community throughout the duration of the courses are as follows:

- Continually monitor the amount, type and effectiveness of discussion in all media, particularly student-to-student discussion
- Administer periodic interviews and web-based questionnairesto students to gather qualitative feedback about reactions to the level of community they are experiencing and its usefulness to their learning
- Look for evidence within all communication media of resource sharing and/or inter-community encouragement or support
- Compare progression of reflective essays of students to identify evolution of self-assessments that indicate personal commitment to the community or deepening of learning and thought about key issues discussed among members

We do not anticipate that a mature community will have been generated from this one semester alone. However, we do expect that the R521 and R511 experiences of these students will create a solid foundation of an infant community that will continue evolving throughout their career in the IST DE MS program. Summative evaluation in the context of assessing community building is useful for determining the overall effectiveness of the online community environment on the students' experiences both during these courses and in future ones.

Suggested methods of summative evaluation are as follows:

- Compare pre-and post-course attitudes of students regarding confidence with working collaboratively with a distributed or online project team
- Compare pre- and post-course opinions of students regarding their comfort levels with and reactions to collaborative projects
- Assign a final reflective essay in which students describe a personal action plan for applying the experiences and knowledge gained through the course, specifically those relating to collaboration and communities

- Perform longer-range (e.g., 2-3 months later) follow up interviews and surveys with students that engage them in reflection on the impact of community and collaboration on courses taken after R521 and r511

Finally, we intend these strategies of evaluating community building in R521 and R511, although holistic in spirit, merely as a framework on which more specific and precise assessments can be constructed. We believe deeper exploration of success factors in fostering online community would be a very fertile topic for further research and warrants further investigation.

Questions for Further Research

Beyond the evaluation of the success or failure of community in the Fall 2000 Distance Masters Core, there are other topics worthy of research.

- What are some valid measures of community development?
- If community formed, what was its effect on the learning?
- How can learners be motivated to take part in virtual academic or social community activities?
- What are special features of "forced community" like the Masters cohort?
- What is the expected/observed life cycle of the Distance Masters learning community?
- How does this community develop and maintain its history?
- Should the Distance community be integrated with the residential graduate community? If so, in both academic and social ways? If so, how can this be accomplished?
- How can the community best be mentored?
- What are the different roles for instructors, graduate assistants, volunteers, upper-year IST students, etc?
- What communication/collaboration tools foster the development of a learning community?
- What are the best practices for using existing communication tools in distance education?
- What tool features lend themselves to different aspects of collaboration and community-building?
- How appropriate were the tools chosen for Fall 2000 in terms of collaboration and community formation?

Conclusion

Having determined that richer learning takes place within the context of a learning community, this report provides background descriptions of characteristics of community and, more specifically, a virtual learning community. We discuss the goal of moving a cohort to a learning community through scaffolding activities rooted in the communication formats of discussion, cooperation, and collaboration.

The report then treats the Core classes in three separate sections: Core (principally orientation and the online café), R511, and R521/522. The courses are described, instructional strategies and rationales are presented, possible assignments are detailed, and an instructor checklist is provided.

Finally we thought it necessary to determine some strategies to evaluate a) whether community has formed within the cohort, and b) in what ways the community contributed to deeper learning. We also provide some possible topics for further study.

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A DESIGN OF ELECTRONIC PERFORMANCE SUPPORT SYSTEMS

Feng-Ru Sheu
Indiana University

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Abstract

The purpose of this paper is to provide an overview of what steps were taken to create an electronic performance support system (EPSS) prototype for Instructional Systems Technology (IST) doctoral students to help them prepare for the Qualifying exams. Throughout the design and development process of the EPSS, the principles of socio-technical design and knowledge management were used. To allow for a participatory design, we used a qualitative approach to collect data, and this was followed by interactive designing of the prototype. We used rapid prototyping and usability testing so that the prototype would be customer driven and meet the needs of the end users.

1. Introduction

The project described in this paper was organized to build a supportive environment for IST doctoral students at Indiana University-Bloomington to help them prepare for the Qualifying exams. We seek to improve productivity by honing the skills and tools they need and providing a supportive environment where students can collaborate and seek advice from e ach other during preparation. During the process, the concepts of information, collaboration technology, learning and work style, tools and management became important in building the support system. The perspective of socio-technical design, knowledge management, and human approach were applied throughout the process.

This paper covers the process of designing this system. With reference to the screen shots and the reflections to the design challenges, we hope to instigate readers to continue from where we have left off and/or to explore future developments on EPSS design/creation.

2. Design Problem

This section of the paper presents a basic description of the IST doctoral qualifying exam process. It then discusses some basic features of EPSS. Finally it discusses the semester's design challenge[1]: to build an EPSS to support doctoral students preparing for the qualifying exams.

2.1 The Qualifying Exam Process

Qualifying examinations are an important milestone for doctoral students in almost any graduate program. In the IST program, doctoral students must pass a written qualifying exam as well as an oral qualifying exam before they are admitted as official doctoral candidates and allowed to proceed with their dissertations. Many students view preparing for the qualifying exams as a hurdle that they must get over before moving on to more meaningful research/work as a graduate student. It is a process, which traditionally causes a lot of stress for the individuals preparing for the exams.

Recently, in the IST department, the qualifying exam process changed. In the past, the qualifying exam was based on a closed book format. Over two four-hour sessions on consecutive days, the students had to answer a series of short essay questions with the purpose to be able to analyze and synthesize their knowledge of the field of instructional systems technology. The new process, called the "authentic Quals" gives students a period of three weeks to write three documents on given topics. The documents are not

[1] This is a one year on going project. Paper was written primarily based on the first version of EPSS we created.

essays but rather formats (such as grant proposals, journal articles, etc.) which resemble the types of writing that doctoral students will be engaged in as researchers.

2.2 Electronic Performance Support Systems

While there is still some debate regarding the definition and function of electronic performance support systems (EPSS), the term generally refers to some type of electronic integrated system or infrastructure which provides access to information and tools which enable individuals to achieve a high level of performance. Gery (1991) explains that an EPSS is custom designed to provide access to information, learning activities, and expert consultations at the moment of need. Brown (1996) explains the role of an EPSS: "[An EPSS provides] a context within which work is done. Everything needed to do the job--information, software, expect advice and guidance, and learning experience—is integrated and minimal support and intervention by others....." He adds that the concept of the EPSS is a shift away from viewing workers/performers as "people to be trained" to viewing workers as "people who need support on the job." An EPSS concentrates on the performer, the job, and job tasks.

Corporations are benefiting from the implementation and usage of integrated electronic systems (Borwn, 1996; Raybould, 1995). For example, a large corporation may combine its many electronic tools (including databases, word processing, e-mail, calendars etc.) to facilitate easy access. This can increases the worker's efficiency (Gery, 1991; Kavat, 1997; Raybould, 1995). In addition, an EPSS can also increase the efficiency and productivity of a worker by providing just-in-time coaching and tutorials that can reduce the learning curve and improve performance. For example, a manager needs to write a performance appraisal for an employee. An EPSS can provide this manager the employee's profile and work performance, give the manager advise messages of how to review the employee's performance, and provide a short learning module on how to write performance appraisals.

2.3 The Quals EPSS

The design problem we were faced with was to design an EPSS that would support doctoral students in their preparation for taking the qualifying exams. Although EPSS development and use are more commonly found in the world of business, educators have begun to explore EPSS applications as well (Chiero, 1996). More recently, integrated electronic systems (EPSS) have been developed for use by teachers in grades K-12 (Kavat, 1997) as well as for special education teachers in behavior management (Hung, 1998). For example, an EPSS can provide assistance with the task of creating an individualized lesson plan for a student assessed with learning difficulties in a particular subject. An EPSS can help teachers establish, maintain, and facilitate an effective work environment by improving the performance of their daily tasks. Based on the success of this integrated model, this study is important in discovering the need and benefits of developing a similar system to help doctoral students improve the efficiency of their work/study performance.

We believe that using an EPSS design for the performance support of qualifying exam takers is a good match. The main characteristics of doctoral students' work for Quals are to master the skills of developing their own ideas once they have located, organized, evaluated, and synthesized the existing literature. This is similar to the work in many large corporations and educational settings that have benefited from EPSSs in the past. Also the tasks/works that relate to Quals preparation involve vast amounts of knowledge, technology, and high performance expectations. These features are a few of the major reasons that Brown (1996) mentioned in outlining when an organization/institution should choose an EPSS solution.

3. Design Process

3. 1 Needs Analysis

In order to design a product that will enable people to work effeciently, we must define and understand how they work and what they need to do their jobs, as well as the whole environment. We feel that conducting a complete and detailed analysis before we begin designing it is premature. The gradual determination of the finer details of analysis will emerge as the various levels of users interact with a demonstration prototype. At this stage, the focus of the analysis is to list the performed tasks, the process of detailing work flow, and the process and skills. The analysis techniques include interviews, observation, and document analysis.

3.1.1 Participants

We collected data from people who are involved in the quals process, including faculty members, the quals committee, the department chair, and doctoral students. Shown in table 1, the main charactersitics of doctoral students that we considered based on the deparment profile are gender, maritalstatus, work status, transfer students, and quals taken.

Table 1. Characteristics of Participant

Quals Taken		Transfer Student[2]		Work Status			Marriage Status		Gender	
Yes	No	Yes	No	P/T	F/T	None	M	S	M	F
6	7	8	5	12	1	0	6	7	6	7

3.1.2 Multiple-Perspective Anslysis

During the process, detailed tasks, workflow, the process and skills were analyzed from socio-technical and user-centered desgin perspectives. We determined how each task component contributes to the product based on Carr's classification of tasks: accomplishments, ancillary activities, and distractions (1992.) This analysis helped us to derive efficiencies from electronic support. The effeciency is increased by removing distractions, and effectiveness is increased by supporting completion of necessary ancillary tasks and accomplishments.

4. Designing Principles and Rapid Prototyping

Major principles other than user-centered design principles for multi-media, computer system design, goal—to reduce stress, and change behavior pattern.

With the analysis framework and all the behavior patterns we found, 16 categories of needs were emerged. They are:

- Information
- Tools;
- Stress reduction
- Cooperation & collaboration
- Access to resources/information
- Suggestions and tips
- Writing strategies
- Clear expectations
- Language needs
- Physical organization readings
- Individual work
- Reading strategies
- Useful courses
- Time management
- Extenuating circumstances
- Location for study & writing

Then we created and designed "EPSS solutions" which are suggested for each "need" and would emerged in various levels in the system. Again, a socio-technical approach was applied through out the whole process. We discussed each item (task, process, need, and intervention. etc.) back and forth between micro-level and macro-level and among those perspectives and design guidelines we mentioned before. Figure 3 was part of the instrument that we used to facilitate our discussion. It shows a partial log of the discussion. The category of need could be checked for more than one socio-technical area: Work practice, people, environment technology.

[2] Transfer student indicates the students who have been through the "core course" that is required in the first year of the IST master program.

Figure 3: Example of application of socio-technical principles to writing strategies

Category: C2 Writing Strategies			
Work Practice	People	Environment	Technology
X			
EPSS Suggestions			
1. online debates around specific questions (KNOWLEDGE SHARING) 2. connect to R711 area 3. examples and tutorials for each of the writing formats (PERFORMANCE) 4. collaboration with R711 – suggestion to take (KNOWLEDGE SHARING) 5. reference books about how to improve writing. (INFORMATIONAL) 6. contact information for writing labs (INFORMATIONAL)			

By identifying needs and coming out intervention within border pictures and among all possible interaction that we could think of, the major conceptual categories that we would like to support are:

(a) information management
(b) stress management
(c) collaboration management;
(d) productive through embedded guidance, advice, feedback and work metaphors; and
(e) a problem-solving environment that integrates basic tools, information management, collaboration and productivi ty tools in a seamless environment.

The EPSS included conceptual tools such as information managers, collaborative utilities, and guidance (including suggestions, advices, war stories, reflections) and support mechanisms that reflected or embodied "expert behaviors," that we thought are keys that can lead to good performance in the qualifying exams and should be developed for the quals. They were identified from the interviews with those who had successfully passed the qualifying exams[3] and faculty members.

Building around a strong, meaningful metaphor is key in our design. We tried to incorporate a meaningful metaphor into EPSS to allow students envision the process at the early stage and to alleviate the stress that students felt during the preparation of the exams. Hoping this strategy has impact on their behavior, such as start early, clear vision, reduce stress,...etc.. We would like our potential users to actively participate and buy into the EPSS program.

5. EPSS Prototype and Knowledge Management

In this general overview section we explain several strategies that we tried to use the EPSS to address these issues. Some concepts learned from knowledge management literature that has been incorporated into the design will be discussed as well.

5.1 General Design Overview

Two of the main issues that we wanted to address with the Quals EPSS are:

- reducing the stress involved in Quals process
- making the Quals preparation process more meaningful to the professional development of the students

One thing that we wanted the EPSS to do was to be a catalyst for changing the way students perceived the Quals process. We felt that it was important to help students get the bigger picture early on about how the qualifying exams fit into the whole doctoral program and their future professional development. We hope to help students perceive the qualifying exam process as a learning process that is just an extension of the other professional activities they are and will be involved in.

5.1.1 The Bigger Picture

[3] Mistakes made by all takers also played an important role to help us identify key behaviors.

In order to provide a general EPSS tool that would be useful to all students in the IST program, the Quals EPSS was designed as a part of a larger EPSS. This EPSS would allow students to customize their profiles and include components such as the Quals components if they so desired.

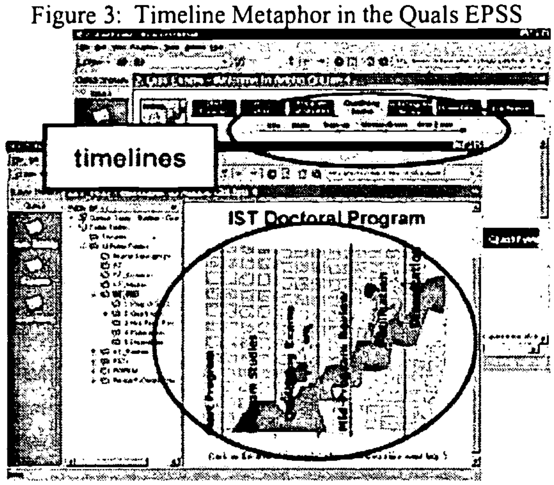
5.1.2 Timeline Metaphor

While the mockup in Figure 3 shows the top level view based on profiles, we also thought that the use of a timeline metaphor for the doctoral student profile would be useful. Figure 3 shows a screen shot of how this metaphor might be integrated into the EPSS.

The use of the timeline metaphor has several benefits that help us to reach the goals of the EPSS. Primarily, it helps to place the Quals EPSS components into the larger framework of getting through the doctoral degree program. In the ideal situation, students would be able to easily navigate back and forth between the different EPSS components. Each "mini" EPSS would help support activities specific to different milestones in the doctoral student timeline.

Part of the impetus for using the timeline metaphor was also to expose incoming students early on in their program to information and tools related to the Quals process. We feel that doing this is a step towards helping students to change their practices of preparing for Quals a semester before.

Figure 3: Timeline Metaphor in the Quals EPSS



Additionally, combining the components under a common metaphor allows for emphasis of skills and other commonalities between major doctoral program milestones.

Finally, within the Quals EPSS components, we continue using the timeline metaphor. Figure 3 shows how the user interface emphasizes the steps that need to be taken in order to complete the qualifying exam process. Prominently featured in the design is the acquisition of skills.

5.1.3 Skills Development Orientation

Another goal of our design was to not only reduce the stress level of studying but to also make the Quals process more meaningful to the doctoral students. The department has taken large strides in this direction by moving to the "authentic" Quals format. We have tried to take it a step further by highlighting within the EPSS three specific skills that will help students to pass the qualifying exams. The skills are:

- Reading Skills
- Writing Skills
- Research Skills

Highlighting these three skills is key to the EPSS because these are the same skills that a student must acquire in order to publish, to get through the dissertation process, and to survive professionally.

5.2 Tacit vs. Explicit Knowledge Features

Tacit knowledge includes ideas that are created in the mind of the individual. It also includes the "mental model" or a framework of how we see and perceive the world. Working mental models can include "schemas, paradigms, beliefs, and viewpoints" (Nonaka, 1994, p.16). Tacit knowledge is deeply rooted in the way we behave and think. As a result, an effort must be made to draw it out of individuals and make it available to others. Conversely, explicit knowledge refers to knowledge that is "transmittable in formal systematic language" (Nonaka, 1994, p.16). Hence explicit knowledge may be more readily available to others. We have tried to apply these principles of knowledge management into our design prototype.

5.2.1 Transferring Tacit Knowledge

As knowledge is not static, but rather dynamic, Nonaka refers to several kinds of knowledge conversion: Tacit to tacit, Tacit to Explicit, Explicit to Explicit and Explict to Tacit. Tacit to tacit knowledge creation (labeled socialization by Nonaka) creates types of knowledge such as embedded and encultured knowledge (Blackler) that tend to be found at more of an organizational level. These types of knowledge depend heavily on shared understandings to be created. They can also reside in systemic routines and cultures found within organizations (see Figure 6). We tried to incorporate encultured knowledge by providing scenarios where the user can read about or listen to the process of how one student explains to another what steps they took to prepare for the Quals and what things they would have done differently. It is explained in terms of the IST culture and how work gets done in IST. The process of socialization is one that may be the most difficult to facilitate with an EPSS; we felt that the a system in which people with a shared goal of passing the qualifying exams can meet is one of the first steps to creating a community. We provided students a social space where students can learn in a collaborative effort. In each section of Reading, Writing and Research skills, students can discuss how they would like to share their exemplar pieces, or seek input from each other of how they would answer a question. In addition, there is a space for them to discuss personal issues such as coping with stress. It may be that just having the system in place will provide people with the opportunities to contact each other and begin the process of sharing and creating tacit knowledge. Tacit to explicit knowledge creation (labeled externalization by Nonaka) will most likely generate encoded knowledge (Blackler). Encoded knowledge is information that is conveyed through signs and symbols. This happens when individuals try to codify or physically represent some piece of knowledge. We found that the knowledge of how to successfully pass the qualifying exams were in the minds of the few. This was done by capturing war stories and documenting students who have taken the Quals and share what they thought were good and bad practices.

5.2.2 Making Knowledge Explicit

Explicit to explicit knowledge creation (labeled combination by Nonaka) represents an area where information processing can create new knowledge. New encoded knowledge can be created through this process as well as embrained knowledge. New embrained knowledge could be created as knowledge "that" and knowledge "about" expands due to transformations of explicit knowledge. Through the process of combination we tried to take explicit knowledge that already exists about the Quals and process it into a form that is more conducive to individual knowledge acquisition. This was primarily done by having all the information about the Quals, the reading list and being able to practice skills for the Quals, all in one place. This also allows for group interactions in a discussion forum where ideas are discussed, transformed, and enriched.

Explicit to tacit knowledge creation (labeled internalization by Nonaka) represents what we most often consider to be traditional learning. This is where knowledge in explicit form (often times abstract knowledge) is made tacit by putting the abstract knowledge to use in a real-world situation or, in other words, learning through grounding the abstract in concrete situations. This move from explicit to tacit often times creates embodied knowledge or knowledge about "how" things are done or familiarity or acquaintance with a system. The process of converting explicit to tacit knowledge can also create new levels of embrained knowledge. The process of internalization was included into the design of the EPSS by providing ways for the students to convert their explicit knowledge into tacit knowledge. For example, there were tools to help students take a technical understanding of the writing formats and convert it into tacit knowledge through practice and comparison with exemplars.

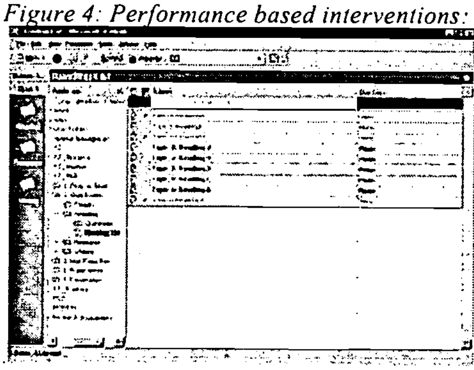
5.3 Quals EPSS as a Productivity Tool

One of the findings from our needs analysis was that doctoral students in general are juggling many different responsibilities and are very interested in improving the efficiency of their efforts especially when it comes to the qualifying exam preparation process. For this reason we believe that the functionality of our Quals EPSS is more heavily weighted towards the productivity end of the spectrum than towards the innovation end of the spectrum. Many of the features of the EPSS (such as sharing advice, war stories, etc.) are geared towards capturing innovative ideas from past Quals takers and making them available in an explicit way to current Quals takers. The idea is that we want the EPSS to improve the productivity of current Quals takers by making their studying efforts more efficient. Making appropriate information readily accessible to the Quals takers is also a way that the EPSS enhances the productivity of its users. A few types of information that are made accessible to the users are:

- Official Information
  - Policy statement
  - Writing formats
  - Ethical issues/ code of conduct
  - Grading rubrics
  - Reading List
- Library/Research Resources
  - Accessing databases (knowing which databases to go to)
  - Keyword / descriptors, related to IST – by topics
  - Using bibliographic info
  - Links to on-line full text / e-journals
  - Links and list of Core journals in the field
  - Basic search skills / strategies
- Bibliographic Info
  - Basics on ProCite and EndNotes
  - Writing format style guides (such as APA)

In addition to providing needed information to students, the EPSS design tried to also focus on creating performance interventions that would help to improve an individual's productivity. An example of one such intervention is providing each student with a checklist of the readings on the quals reading list. The student can then add readings to the list, set a reading schedule, and keep track of what he/she has read. Figure 4 shows a mock up of how an intervention such as this might look in the EPSS.

Figure 4: Performance based interventions: Reading List Checklist



5.4 Knowledge Management Objectives

Davenport (1998) detailed the four following knowledge management objectives:

- Creating Knowledge Repositories
- Improving Knowledge Access
- Enhancing the Knowledge Environment
- Managing Knowledge as an Asset

This section explains how specific features of our Quals EPSS help to accomplish these different objectives.

5.4.1 Creating Knowledge Repositories

There are three main features in our design related to creating knowledge repositories: (1) providing static information, (2) providing dynamic (updateable information), and (3) creating meaningful categories for locating appropriate information.

5.4.1.1 Providing Static Information

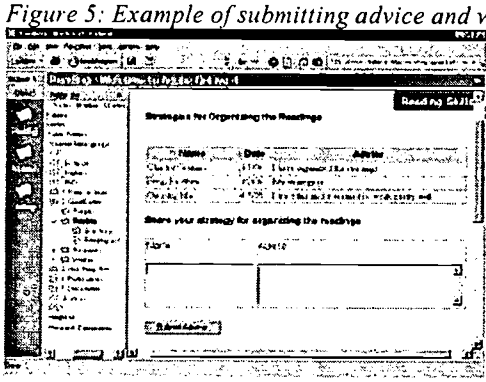
There are lots of specific pieces of static information that are provided through the Quals EPSS. Section 4.3 of this report lists some of them in detail. Static information was typically provided as links to resources or official information. Figure 8 shows an example of a screen shot of a part of the EPSS where static information regarding official Quals information is provided.

5.4.1.2 Providing Dynamic (updateable) Information

There were many ways in which we tried to provide dynamic information to the EPSS user. One of these ways was to provide a space for individuals to post questions and get responses. For this we used the public folder feature of MS Outlook. The EPSS contains a separate folder for each of the main skill areas of reading, writing, and research. Each of these folders has a "Questions" sub-folder where students can post questions they have and get answers posted by other students or faculty members.

Additionally, the EPSS will have forms that allow students who have already taken the exams to submit advice and war stories to a database for students who will be taking the exams in the future (see Figure 5).

Figure 5: Example of submitting advice and war stories



Another dynamic feature of the EPSS will allow students to share information about bibliographic databases as well as the database files themselves. So a student who wishes to use EndNotes may get advice and give advice to others about how to use the tool. The EPSS will also allow individuals to share their EndNotes or ProCite database files with other students. So a student just starting the program could begin with an EndNotes database file that already has the qualifying exam readings in it.

5.4.1.3 Meaningful Categories for locating information

A final area that is related to the EPSS providing knowledge repositories to the students is through its organization of the information into meaningful categories. A knowledge repository is not very useful if you cannot quickly find the information you want within it. In the EPSS we tried to simplify the interface by creating a timeline of tasks related to the Quals and also focusing on skills acquisition (See Figure 11). We felt that most of the critical information fit nicely into these categories. In addition to providing a few

categories, a search capability is also planned for the EPSS, so that the entire EPSS database can be searched for key words.

5.4.2 Improving Knowledge Access

Finding ways to provide improved access to available knowledge was another focus of our design. The primary way we did this i was to provide a mechanism for the sharing of contact information among individuals who are taking the qualifying exams. Figure 12 shows an example of the contact list, which is updateable. Only students wishing to have their names included on the contact list would be listed there. In addition to regular contact information, the contact list gives information regarding when each individual plans to take the qualifying exams.

A few other ways in which access to information rather than the information itself is provided through the EPSS is via access to the Quals preparation listserv, providing contact information for the writing labs, and through access to information and writing feedback available to the R711 students.

Finally, access is provided to library resources. However, we didn't want to just provide links to the main library resource page. So, under the "Research" area of the EPSS we provide access to the specific online journals that are related to our field. We also provide information regarding listings and call numbers for non-electronic journals related to IST as well as search terms related to the field and especially related to the reading categories.

5.4.3 Enhancing the Knowledge Environment

We attempt to enhance the knowledge environment by making it comfortable and useful for everyone that wishes to use it. We tried to do this by using the timeline metaphor that pervades the design prototype. We use this metaphor to try and subtly facilitate a behavior change. We hope that the timeline can serve as a friendly reminder to students of how their preparation fits into the larger picture.

We also attempt to enhance the KM environment by including a scenario in the EPSS. The purpose of the scenario is to get students thinking early on about the issues related to quals and to get them motivated to start preparing for the quals early. In a way we are using the scenario to try and increase "cultural receptivity" to the quals preparation process.

We also believe that the knowledge environment is enhanced through the integration of important skills such as reading, writing, and research throughout the entire Quals EPSS as well as the other EPSS components under the doctoral student profile in the IST EPSS. The knowledge environment is enhanced because familiar themes in the form of skills will surface no matter where the user is in the system.

5.4.4 Managing Knowledge as an Asset

Figuring out how to manage knowledge as an asset was one of the most difficult challenges of the EPSS. There are two main ways that we see the EPSS playing a role in managing knowledge as an asset.

- through acquisition of valuable skills
- through sharing of bibliographic database files – combining assets of individuals to make a larger whole.

Skills such as reading, writing, and research are certainly invaluable assets to any doctoral student. One's ability to adeptly perform tasks related to these three areas is certainly a form of "intellectual capital" belonging to the student. The EPSS helps students to acquire and enhance these skills.

Secondly, knowledge can be captured in bibliographic database files (with ProCite or EndNotes). This might include the bibliographic information as well as short summaries, key words, etc. Once this knowledge has been captured, the EPSS provides an easy way for students to manage and share this explicit knowledge as an asset.

6. Reflections

As we reflect back on the process that we have gone through in rapid prototyping an EPSS to support doctoral students preparing to take the qualifying exams, we feel that we have learned a lot about EPSS design. In particular, both user-centered and socio-technical perspectives and knowledge management have impacted our design.

6.1 Underlying Psychology

As we began to work on the EPSS using a socio-technical design framework, we really focused on the "work practices", the process of work practice, and the interaction with environment, people and technology. We then tried to understand the underlying psychology behind why students do what they do in preparing for the qualifying exams. This focus helped us to identify the components of (1) stress and (2) desire for efficiency that seem to pervade most student's approach to preparing for the qualifying exams. Once we understood this, we were able to develop the timeline metaphor for the EPSS. Also, it became one of the frame factors that helped us to focus many of the interventions within the EPSS towards skills development in the areas of reading, writing, and research.

6.2. Knowledge as Process vs. Knowledge as Object

Another idea that impacted us was changing our conception of knowledge from only "knowledge as object" to also include "knowledge as process." At the outset of the project, our group had the idea that an EPSS was primarily a "knowledge bank" or "knowledge repository" where knowledge objects were stored and retrieved at appropriate times. Fairly soon into the semester, we began to change our ideas as we were exposed to the concept of "knowledge as process." This drastically changed how we viewed the EPSS. Instead of just looking for types of information that we could provide to individuals, we began to look at how our EPSS could actually act as a catalyst to change the way people prepared for the qualifying exams. This led us to try and develop and incorporate more performance-based interventions into our EPSS design.

7. Conclusion

We applied a socio-technical design framework, user-centered perspective, and a rapid prototyping approach to the EPSS design. The design was developed by looking at the work practices and psychological behaviors of individuals currently preparing to take the qualifying exams as well as individuals who have already taken the qualifying exams. The EPSS is built upon the idea that knowledge can be treated both as "object" or "process" and thus incorporates both informational interventions as well as more performance-oriented interventions.

Two of the main (interrelated) goals of the EPSS design have been to (1) reduce the stress of those preparing for the qualifying exams and (2) to increase the efficiency with which the students can prepare for the exams. These goals are achieved, at least in part, by providing an environment which encourages students to begin preparing earlier than a semester before the quals by working to develop skills in the area of reading, writing, and research that will be useful throughout the program as well as in their professional activities. They are achieved by providing the environment that allows students to develop problem-solving skills in the areas of information management, stress management, collaboration management, and productivity improvement.

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Adapting a Master's Course to the Web: Principles, Strategies and Recommendations

Barbara A. Bichelmeyer
Melanie Misanchuk
Larissa Malopinsky
Indiana University

Abstract

The purpose of this paper is to describe the process of adaptation of R522: Instructional Design and Development, from a residential course to a web-based course offered in the Distance Masters program in Instructional Systems Technology at Indiana University. A description of the web-based course, factor impacting the adaption process, and recommendations for adapting a course to the web are also discussed.

In Fall 2000, the Instructional Systems Technology department at Indiana University in Bloomington began offering its 36-hour Master's' degree program at a distance. Half of the 17 students who enrolled in the program are from Indiana; the rest are from out of state, spanning three time zones. Just over half of the students are women; the group is evenly split among those who work in K-12, those in higher education, and those in the corporate field. The projected time to complete the program being 3 years, and during the first semester of the program, the students enrolled in four hours of coursework: R521: a one-hour orientation to the field, and R522: a three-hour course about basic instructional design and development.

R522: Instructional Design and Development is the first course the core set in the IST department. Students in the regular residential program come in as a group and go through a core set of courses; two in the Fall semester and two in the Spring. The other usual Fall course is R511: Instructional Technology Foundations I, an introduction to and history of the field. The students tend to take the core set together throughout the first year of the program, after which they have more traditional individual choice of courses for the rest of the program.

R522 is an in-depth explanation of instructional design; the students are introduced to the ADDIE model and instructional design theories, and also work on usability, formative evaluation, and visual design. The deliverables for the course include two projects; students develop materials to teach one concept and one procedure. Therefore, they become familiar with at least two different instructional design theories for each type of instruction, and follow the procedures for materials design and development for two projects.

The IST program focuses heavily on group work; students enter the program and immediately begin working very intensively with teams. The program is also project-based; students work in their teams on two large projects throughout the semester. We wanted to maintain this approach in the online Master's program; the ideas of intensive group work and thorough materials production at a distance were the first few challenges of designing this course. Our program also emphasizes reflective practice; students not only on look at their finished product, but are also required to reflect and write about the group process, group dynamics, team functioning, as well as on the instructional design process itself. Student write weekly e-mail updates throughout the semester, as well as a project report at the end that discusses the design process; there is as much emphasis on process as on product. Finally, we wanted to maintain a feeling of community among the students. As alluded to earlier, about 50 students, both masters- and doctoral-level, enter the program every fall. These students go through core together and really start to develop a sense of community; they feel like they're all going through boot camp together. This feeling of community and interdependence is another thing that we wanted to replicate in the Distance Master's program.

In the residential program, incoming students have a one-day orientation session the week before school starts. They meet each other and the faculty, have tours of the department and the School of Education, and have a general introduction to the program. They spend the next number of weeks getting to know each other in classes and in the social spaces in the building. The Distance Master's students would not have this latter opportunity, so we created a 4-day on-site orientation program for them. The week

before the beginning of the semester, all of the distance students came to Bloomington to engage in a variety of content-based, group-building, and administrative tasks. We wanted to instill a "boot camp" feel to the orientation to replicate what the residential students go through in their first few weeks of core. We decided that if we were serious about the community aspect of the program, we would have to emphasize it from the beginning, and that would include bringing students and faculty together face to face.

The problem that we were trying to address in designing a web-based version of R522 was how to create an online course that matches the residential experience in terms of assignments, criteria, the problem- and project-based nature of the program, the emphasis on teamwork and group-based interactivity, the implementation of reflective practice at several levels, and maintenance of a community of learners and cohort support.

The purpose of this presentation is to describe what we went through in the planning, development, and implementation of a flexible online course based on our principles, which we have taken to be learner-centered design, knowledge construction, active learning, collaboration, and multiplicity.

Lessons from the literature

Learners thrive in learning communities. We know in the distance situation, students who are geographically remote from the instructor and other learners can feel a sense of isolation. One way of reducing the feelings of isolation is to know that you have a number of people you can count on and who are doing the same things and going through the same things on the other side of the country. Being part of a community reduces attrition. It is well-known that when people feel part of something, they are less likely to drop out because they know that someone else is depending on them. If a student is working on a group project, then suddenly decides she really doesn't feel like continuing with the program, what keeps her engaged is knowing that others are counting on her. The more that learners need each other, the better we are in terms of keeping them in the program (Palloff & Pratt, 1999; Raymond, 1999).

Learners in an online format need a great deal of curricular, instructional, and technological support (Sewart, 1993; Morgan & Tam, 1999). All of these are important in any course, and at a distance, their needs are magnified with regards to the technological support. A number of presentations at this conference were about a certain online course, but students came to campus anyway. This is not the case for us; since half our students are out of state, as far away as South Dakota and New York, coming to campus is not an option. If these people could come to Bloomington, they would enroll in the residential program. But they can't, which makes them extremely dependent on technological support. It is critical then, that these students be able to access to the kind of supports they need in order to achieve the goals of the course, whether those supports are library readings, grading rubrics for assignments, presentation materials, or technological tools.

Learners need frequent and meaningful interaction with the instructor. It also goes without saying that, in any course, learners seek interaction with the instructor. In a distance format, when students don't have the luxury of coming to class every week and seeing the instructor, they have to fulfill their interaction needs in other ways (Kirby, 1999; Crouch & Montecino, 1997). We remained cognizant of these differences and worked to build in other opportunities not only for learner-instructor interaction, but also for learner-learner interaction.

Activities should be task-based. Because students who take online programs are often working fulltime, perhaps even in the field, they tend to favor the practical over the theoretical. Therefore, the projects must be not only applicable, but authentic and meaningful as well. Evaluation therefore should be authentic and based on those tasks (Nelson, 1998).

Learners should be actively involved in the evaluation and improvement of the course (Cheung, 1998). Our students, being the first cohort to go through the program, know they are working with a double-edge sword. On the one hand, they have the opportunity to almost mold the class to their needs. On the other, they are working with a fledgling program that is still working out all its kinks. Later in this paper we will describe the dialogue we have with the students about course improvements.

The final major theme we found in the literature was that of faculty support. It is important to offer not only release time for teaching online – which is, in general, much more time-consuming than teaching in the regular classroom, especially in the case of a new class – but also provide remuneration for any course development the instructor is involved in. Just like students, faculty will need extensive technical support; professors who are not instructional designers can also benefit from instructional consulting help when working in the new format (Saba, 1999; Schifter, 2000).

Description of the web-based course

There are three major components of the R522 course. First is a website which is a one-way communication vehicle in which the professor provides the students with a great deal of information about the logistics, the topics, and the requirements of the course. All of the instructor-produced content resides on the web site, including links to other resources and information about books and other references. The second part is an asynchronous discussion forum in which students engage in online synchronous and asynchronous conversation. They can work at a class level, posting messages of interest to all the students; they also have private team areas that are open only to team members and that other students and the instructor cannot view. In addition to posting and replying to messages, in any of these areas students can post URLs for others' reference and can upload documents, such as their project reports or the instructional materials they are creating. The final element in the course is an e-mail listserv through which the instructor can communicate with all students quickly. Because e-mail is a "push" medium (the message arrives in their inbox), it offers more immediacy than a "pull" option like the forum (where students have to go to a particular URL to read a message). Students can also communicate with the entire class via the listserv if they so desire, although thus far they have very rarely taken this opportunity. There have been four iterations of this web-site and forum to this point (the middle of the semester), so it truly is an on-going design process of design and development for the on-line resources of this course.

The website is one-way information from instructor to students. A "home" link introduces the IST program and the course, with each student's digital picture there to give a feeling of community, so that the first thing students see is their classmates as a reminder that they are part of the larger community. This function is helpful not only for the students, but also for the instructors and staff to remember the students they met at the orientation and to put a face to a name.

Also on the index page, the "contact information" link lists how to get in touch with the instructor, the two graduate assistants who deal primarily with technological support, the program coordinator, and department offices for program and future course questions.

The "syllabus" link provides students with everything they need to know about how the course is run, including the course philosophy and approach, objectives for the course, assignments, evaluation and grading. Demographic information provided includes class meeting times and e-mail office hours. Office hours have been set so that students know that, no matter when they send e-mails to the instructor, there are two times during the week when emails will be answered. This alleviates the concern that "I e-mailed her an hour ago, why hasn't she answered me yet?" Class meeting times (live chats) were established as a metaphor for a class meeting: getting to "see" everyone at the same time and having the instructor there in real time to answer questions in front of everyone and "asking in front of the whole class" rather than replicating private e-mail conversations with the professor. (The weekly chat is the only mechanism that combines the two elements of timeliness and publicness; if you post in the forum, you lose timeliness - if you send private e-mail, you lose the publicness.) Basically, the syllabus is the contract with the students for what they will complete in the course.

The "schedule" is the driving page of the website. This is where the students go in order to manage and work through the course. The schedule provides a weekly calendar of presentations, discussion topics, and the deliverables due for the week. Each "presentation" includes detailed information such as the objectives of the discussion, an overview of the key points of the discussion, additional resources they should read to become more familiar with the topic, and questions for reflection. The "deliverables" links take the students to assignment pages which specify the date due, the point value and percentage of grade, any instructions for completing the assignment, and evaluation criteria so that students know how the assignment will be graded.

Also on the index page, the students find links to a "resources" page that provides a list of all materials students need to complete the course. The "turn in your work" link takes the students to a password protected fileserver where they upload their completed assignments to the instructor, so that the instructor does not have to go search through the forum or to deal with e-mail attachments every time the students hand in assignments. The "gradebook" link is a feature provided through the University Information Technology Services and Bureau of Evaluative Studies and Testing (BEST). Here, the instructor can create a Microsoft Excel spreadsheet with students' grades and narrative comments, and then post those to a password protected fileserver from which students can access all their grades and comments. The index page also features links to an "evaluation" website which is also administered by BEST and where students complete midterm and final course evaluations. The index page also includes links to a site map, a "frequently asked questions" page, and the class Sitescape Forum.

The second technological element of the R522 course is the asynchronous discussion forum. The university has had a SiteScape Forum license for at least three years, and this software is used to create a virtual meeting space for the course, where learners can discuss issues related to the class with each other in both synchronous and asynchronous formats. The R522 class forum includes four distinct spaces: first, there is a weekly discussion topics space where students go to interact with the instructor and other students regarding topics such as analysis, design, development, usability testing, creating instructor materials, implementation, evaluation, visual design, web authoring, concept learning, procedure learning, group skills for instructional design, and being a reflective practitioner. A second space in the class forum is devoted to group dynamics, and students use this space to discuss the readings about group dynamics that are required for the course. Third, there is a general discussion area where students can talk about any topics or issues related to the course, but not specifically focused on weekly discussions or group dynamics. Finally, each student team has a private space which is password-protected space and where they can go to communicate, share documents and work on their project deliverables. There is one other SSF space that is, strictly speaking, at the program level, not the course level. The Core Café is a space dedicated entirely to social and non-R522 topics. At the orientation, the students were involved in designing a metaphor (a town) for this student-run space, and emphasized that it could be used for any non-R522 discussion. Students could post messages about their personal lives and jobs, could add links to personal and career-related web pages, could post hints for technical problems, etc. In the beginning there was a good level of activity in the Core Café; however, postings in the Core Café have dwindled to none. It is possible that once the students have a need to communicate as a class (i.e., not just on their project teams), about which other courses to take, etc., that discussion in the Core Café will pick up again. It is something that we are actively watching for research purposes.

The third technological element of the course is the class listserv, which is used primarily by the instructor to communicate public information that needs to go to all students at the same time. Because of the immediate nature of e-mail, the listserv is used for announcements that require a timeliness and priority that would be ill-served by posting in the SiteScape Forum. The listserv is used by the instructor to provide reminders of deliverables due, to make changes in weekly plans, the send out clarifications regarding criteria for assignments, etc.

Instructional design process for adapting the course

Collaborators in course design

Our design process was a collaborative effort with five stakeholders/groups. The client in this design project was the instructor of the course, who has a great deal of experience in instructional design and web development. Given this expertise, the client was able to provide both subject matter and technical expertise regarding the course design. The Director of the Distance Master's program was also a key stakeholder in the design process, as it was expected that the design of this course might serve as a template for future IST Distance Master's courses. The IST Department Chair was a third key stakeholder in the design process, concerned with administrative aspects of the course as well as the relationships between the Distance Master's course (R522), the Distance Master's program, the residential program and school requirements. The fourth stakeholder group, the course designers, consisted of a team of five advanced IST students, who worked either as instructional or interface designers for this project. These students were either enrolled in advanced design and development courses, or submitted the design of this course as a development project, which is required for completion of an IST degree. Finally, in addition to these key stakeholders, students who had previously taken R522 courses were also involved in this design project, providing valuable input regarding the instructional and interface designs for the course web-site.

Guiding principles for course design

Four fundamental principles guided all aspects of design and development for the R522 course website and forum. The first principle was that the web-based course must be of comparably high quality to the residential course; it is not acceptable to have a "R522 light" for distance students – or to differentiate the quality of experience our students received in the course based on the course format. Secondly, the web-based course must serve as a model for future web-based courses to be taught in the IST Distance Master's program, which meant that the technologies used to support the course and the interfaces used to present course materials could not be so highly specialized that they would be difficult to replicate in other courses. Third, the development process used would have to foster faculty ownership and commitment to the web-based course and the Distance program because we believe that faculty involvement is critical to the overall success of the Distance Master's program. Finally, the design team proceeded from the assumption that an iterative model of design and development would be most appropriate for adapting the

R522 course from the residential program to the web, because the iterative approach would best allow designers to address the interactions between content presentation, instructional processes and interface elements, and to adjust the course design as appropriate.

Process of adaptation

The following process was used to adapt the residential course to the web-based environment described above. First, the design team met with the instructor to confirm the goals and objectives of the course, and to make sure that the goals and objectives were similar to the residential course. Second, the instructor identified the major content components of the course and considered how these components would best fit in the web-based instructional environment (the major components of the course were the instructional design process, instructional theories and group dynamics and critical reflection regarding instructional design and teamwork). Having determined the major components of the course, the third step of adaptation was the establishment of an overall technology strategy for the course (at this point, the instructor and designers agreed on using web pages to provide instructional materials, using the SiteScape Forum to foster group interaction and team interaction, and using the listserv to communicate time-sensitive messages to the entire class). Having identified the course components and the technology strategy for the course, the design team worked with the instructor to design an interface that would best reflect the priorities of the course and emphasize the major course components. The interface design process involved the identification of specific web-pages and forum links that would be needed, as well as deciding which elements would be needed on each type of page. The result of this step was the development of templates for each element of instruction (templates for the schedule page, presentations pages, assignments pages, resources, pages, etc.). Once a list of components had been identified, the instructor and the interface design team undertook discussions regarding the relationships between the various web pages and forum spaces in order to determine the most appropriate navigation paths and navigation structure for the course website. With templates for specific web-pages and a navigation structure in place, the design team turned to the task of gathering the actual instructional materials from various subject-matter experts, textbooks, journals, web sites and personal experience to write the content for the presentations pages and to develop the other content materials that were needed for the web-based course, which was step six of the adaptation process. These content documents were produced in Microsoft Word 98 and saved in rich text format, so that they could more easily be imported to html editors and coded as html files, which was the next step of the adaptation process. After html files were created, the files were usability tested with several representatives of the target audience, identifying changes to be made and updating the pages based on target audience feedback. The web-site was then ready to be uploaded to the university file server where it was tested for functionality and compatibility. We learned that there were some compatibility issues between the Unix commands used by the university servers and the programming code used when creating html files with Microsoft's Frontpage web editor software, resulting in the need to re-code a number of html files. During the onsite orientation, we showed the students the course web-site and trained them in its use. At this time, students also received training on the basic features of the SiteScape Forum, the group editing features available in Microsoft Word, as well as basic skills of teamwork and group dynamics. We felt that the course design would not work if we did not train the students in how to implement the design; and for this reason, an orientation was designed not only to provide students with the skills and knowledge they would need to be successful in this program, but also to give them the tools and technologies that would support their skills and knowledge. Based on this orientation experience, students began immediately to provide comments and recommendations for improving the web design, so a mechanism was created to gather their input, and these inputs are used for periodic maintenance and upgrading of the course website. We are now engaged in ongoing monitoring of the university's technological capacity to make sure that we are continuing to provide our students with a course website that is most appropriate to the goals of instruction and best addresses students' needs given available technologies.

Factors impacting the adaptation process

Given the design process that has been outlined above, the purpose of this section is to discuss some issues that have probably impacted our development process, which would need to be taken into account by others who are planning to adapt a residential course to the web environment.

Instructor experience and openness to innovation

First, the instructor's background and experience with instructional design and with technology impacts how easy or how difficult it would be for a team of designers to come in and work to create a product quickly. In our case, the instructor was a designer and an experienced computer user, so she had a

very good grasp of both the process and the product she wanted. Working with someone who had varying degrees of experience in pedagogical strategies, instructional design, and communications technology would require different things of the design team and would yield very different results.

It is doubtful that an instructor would be willing to teach a web-based course if that person were not in some way open to innovation, yet instructor willingness often has little to do with what they end up teaching. The degree of an instructor's openness, willingness to risk, and acceptance of ambiguity will very likely have an impact upon how successful a web-based course may be.

Technological capacity and infrastructure

With the development of each course, there is a struggle to balance the competing issues of what technologies will be supported by the university, what is the greatest level of functionality that can be offered, what is the lowest common denominator of student technology that must be considered, and what technologies will be most easily accessible and cost efficient for students.

Rationale for adaptation to web-based instruction

For an IST department, the creation of a web-based program works not only at offering our program to those who cannot come to Bloomington, but also allows us to practice what we preach. In the tradition of the old lab schools, it gives us an opportunity to implement our ideas, to see if what we are reading, teaching, and proposing for others really does work, and what the issues are. It gives our students an opportunity to be involved in the design, development, and maintenance of a program before they go out into the world to create their own. The reasoning behind the creation of web-based instruction is likely to impact the design emphasis, as well as the time that can be dedicated to the adaptation process. If we didn't have students pushing us for this type of experience and needing to have this type of experience, we may not have been so quick to create the Distance Master's program.

Fit of course goals with technological capacity

Another factor that impacts the adaptation process is the fit of course goals with technological capacity. How much of a project-focus, readings focus, team-based focus, and individual focus there is in a course will determine what type of web-based design is needed. For example, all of the instruction and interaction in R522 is text-based. In the Spring, we will offer R541, a production course in which students do individual projects in Director, a web page, an audio presentation, and video presentation. The content of that course will greatly increase the technological needs and will require different tools and ways of working.

Labor force available for course adaptation

The instructor of this course could not have created the course materials alone. Fortunately we had graduate students who needed and wanted this experience and who were willing to work for course credit or to complete a required development project – if we hadn't had that labor force, it would have been all but impossible to get this material developed in the six-week time frame during which it was completed. The make-up of your labor force may differ: you may need to do much of the instructional design on your own and delegate the web development to others. Your time-frame may permit a few people to work more slowly on the development.

Technological equipment and sophistication of learners

As the faculty member teaching this course, one of the things that I'm most appreciative of is that the program development team created a set of minimum technology standards for the students, and told prospective students that they could not enroll in the program if they didn't have technology that met these basic specifications such as processor speed and modem speed and number of phone lines. We designed with a certain expectation in mind, and even then, we have made changes to make sure that we addressing the lowest common denominator of technology sophistication so that we aren't leaving any of our students behind. Nonetheless, we think it is not a burden to require that Distance students have more sophisticated computer equipment and connectivity capacities than residential students.

Learner motivation for taking the course

We have been trying diligently in the design to create an environment in which students really want to collaborate with team members, and to be engaged in community. We continue to think in terms of the design about how best to address community. The challenge with this type of program is to learn how to balance the interests of independent, self-motivated learners with the need to build professional community, to match those interests with the goals and purposes of the program, and to try to design a course website that links the goals of the learners with the goals of the course.

Administrative support

We have two graduate assistants who are full-time technology support for the course website, and this frees up the instructor to spend time addressing the curricular and instructional issues related to the

course. Without this administrative support, it is highly likely that most of the instructor's time would be spent doing trouble-shooting and problem solving with respect to technology. An example of the type of things the graduate assistants address include whether chat programs should be used for team collaboration, which chat programs work best, and dealing with the times that university servers go down and students can't access forums or the class web-site.

Tuition and fees

There is an outstanding question as to whether the return on investment outweighs the costs of creating and implementing web-based courses. The need to generate revenue from a Distance Master's program, at some point, will become a factor that impacts the design and adaptation of residential courses to the web environment. The fact that our department is committed to this program in order to provide instructional design, development and research opportunities for our students means that this Distance Master's course and the program as a whole have an entirely different impact on our department than would be the case if the primary concern of our department was to generate revenue from this program.

Recommendations

Start development early

The initial development of the course described in this paper occurred over a six-week period from July to August 2000, and required approximately 500 hours of labor from a development team of five individuals and the instructor of the course. Obviously, the more people you have available and the more time you have, the better. Although the course development took only six weeks, the administrative and department-level foundation had been laid over the previous 6-12 months. Even if you do not begin designing right away, you need to start talking to the stakeholders, setting out requirements, getting faculty, staff and administrative buy-in, and dealing with bigger-picture issues.

Confirm capacity of technology to address needs

Confirm capacity of technology to address needs. Does the university provide the technological tools, software programs, and administrative support that will be needed to create a successful distance learning experience? Make sure that the programs and software you choose are appropriate for the delivery mechanisms, for your students, and for your content. While not asking for new equipment and software costing thousands of dollars, require a solid minimum set of technology standards that your students will meet. Provide faculty with the best equipment and connection possible, from the office and from home.

Develop policies for ownership of materials

There is much discussion of who owns what in the creation of online courses. Each university has its own policy. Make sure you are familiar with yours and that your faculty agree to abide by its terms. These polices can act as disincentives for faculty to create excellent online instructional materials, so communicate with administration about potentially updating and modifying policies that are too restrictive or that flout general intellectual property rules.

Have minimum technology standards for students

As was previously mentioned, learning at a distance requires certain tools that are different from those a regular student may need. Stating explicitly what students will require is useful in that students can compare their present capabilities to the minimum standards and have good guidelines on upgrading. Additionally, if they want to buy a new computer, they have the standards at hand. Our university, like many others, has special hardware and software deals with a variety of companies that the Distance students can take advantage of. In our team-based program, if one student cannot connect or complete the work because he doesn't have the software, it is not just his problem, it is his team's problem, and therefore the class's problem.

Provide detailed technology training for learners

Residential students and faculty have enough problems with getting their technology to work smoothly. Students learning at a distance are exponentially challenged to learn and troubleshoot their technology problems. In the residential IST program, students with questions can easily find someone in the lab or in the hallway to help them. The Distance learners may have no one within 500 miles who is working with this software and therefore must rely only on himself and the available resources. To this end, we not only gave students a crash course in much of the software and tools they would be using, but also taught them how to trouble shoot and where to go for help. There is a telephone help desk that they have access to, as well as Indiana University's Knowledge Base, an award-winning technology information database.

Provide learners with guidelines for when to use each communication vehicle

We offered very little guidance about which tools were best suited, according to our research, for what kinds of communication. Some of our teams did everything from team meetings to actual writing and development, completely synchronously, which ended up being long chat sessions that were useless to them later, and $100 conference call phone bills. This is not surprising that students will take a while to figure out the best methods for communicating in the new way. Because students are used to meeting face-to-face and talking, they assume that the chat format works for every kind of interaction. In the future, we will offer students guidelines of when to use the Forum, when to use chat, when to use e-mail, etc.

Test-adapt-test-adapt-test-adapt

It is highly unlikely that the first version of the course website created will be the best or most effective one, so you should plan for and engage in at least several iterations of usability testing with representatives of the target audience, and use the results of those tests to adapt the website in order to improve the educational experience for the learners.

Recognize that all faculty are impacted by the implementation of a single course

One faculty member in isolation will not be able to design, develop or implement a web-based course. It takes the support of an entire faculty to complete this process. Additionally, the department as a whole needs to have buy-in to the process and the product. If there are faculty members who see the online version of the program as being watered-down and therefore less valid than a "regular" degree, these concerns need to be addressed. Chances are good that during the development and first implementation of online courses, the lead faculty member will have to lessen her other departmental responsibilities, and the other faculty members have to be willing and able to pick up that slack. Although some faculty may never teach in the online format, they may be asked to "guest lecture" or find other ways to interact with the Distance students. Even if they have absolutely no contact wit the online program, their lives and jobs will be affected by the program and therefore they are important stakeholders in the process.

Conclusion

The process of adapting a residential course in Instructional Systems Technology to a web-based course for a distance masters program has been a challenging, and at times, a difficult experience. This process of adaptation has required that the instructor and the instructional design team grapple with issues of technology support, software capabilities, the collection and dissemination of course resources, the technological skills of learners and faculty, and the motivation of learners and faculty to create and sustain community. It has required that the instructor move out of the comfort zone of familiarity with the residential learning environment to consider what aspects of that environment are most appropriate and can best be replicated in an on-line environment, and what unique features of the on-line environment can facilitate learning.

Each adaptation of a residential course to a web-based environment will be in many ways unique and non-generalizable, as is the case of adaptation for the R522 course which has been described here. Yet, consideration of the experiences of this instructor and instructional design team may offer some insight to those who are in the process of adapting other courses to web environments of issues that impact adaptation, including course objectives, technological capacity, and learner skills and knowledge related to the use of sophisticated technology.

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HUMAN-CENTERED DESIGN BILL OF RIGHTS FOR EDUCATORS

William A. Sugar, Ph. D.
East Carolina University

It appears to be a ceaseless question on determining the best ways to incorporate technology within public schools. Though the past relationship between the Instructional Technology discipline and public schools has been tenuous and limited (Heinich, 1995), Willis, Thompson, and Sadera (1999) recently present encouraging news. They summarize the current research of a new sub-discipline within instructional technology: information technology and teacher education. This new field offers effective solutions to encourage technology adoption and integration within public schools. This article presents another potential solution by proposing a human-centered technology bill of rights for educators. The intention of this bill of rights is to influence educators' beliefs towards technology and to enable educators to confront the seemingly mesmerizing host of new technologies with confidence.

Instructional technology in the schools: Allegiance and resistance

Throughout the last century, pubic support for the use of new technologies in the classroom has been sympathetic and promising. New technological gadgets (e.g., Edison's kinetographs, instructional television, filmstrips, videocassettes, and now, DVD players, etc.) have been designated as "champions" that will help facilitate the ultimate technology integration and revolution in schools. The general public tend to view technology as being "positive" overall (Kerr, 1996). This allegiance appears to be somewhat of a blind frenzy where there is an "initial wave of enthusiasm for new technology" (Cuban, 1986, p. 4). In fact, Segal (1996) describes this phenomenon as "technological utopianism" whereas Mellon (1999) characterizes the current allegiance to technology as a worshiping act.

However, the "Field of Dreams" syndrome[4] does not apply to educational settings. Even though new technologies are proclaimed, introduced, purchased and adopted by schools, teachers are resistant to "modern" technologies and are reluctant to accept new technologies (Cuban, 1986, p. 2). In most cases, technology is "hurled" at teachers when "non-teachers" introduce and originate new technologies into schools through top-down mandates (Cuban, 1986, p. 54). This is currently the case. Public schools are well equipped with computers, but all to often teachers do not regularly use this technology in their classrooms (Cuban, 1993; Office of Technology Assessment, 1995). Though Becker (1998) reports promising news for Internet use among teachers, universal acceptance of new technologies among teachers should not be taken for gránted.

Immature and mature views of technology

Despite this initial enthusiasm, reluctance, and resistance, individual teachers have successfully adopted and integrated technologies within their classrooms. However, there have been inconsistent technology adoption styles and usage among teachers (Dexter, Anderson, and Becker, 1999, p. 221; Office of Technology Assessment, 1995). These different styles can be categorized as an *immature* view of technology as opposed to a *mature* view. An immature view perceives new technology as an add-on or supplemental activity and develops routine instructional tasks (Willis & Mehlinger, 1996, p. 984). With a top-down approach, Fabry and Higgs (1997, p. 389) report that new technologies have been forced into schools which "typically results in superficial adoption rather than incorporating the substance." Ely (1997) comments that new technologies (e.g., computers) "rarely supplant other media and methods" (p. 104). A mature viewpoint of technology goes beyond this superficiality and views a particular technology as a tool to facilitate learning (Office of Technology Assessment, 1995). Thus, this new technology is not supplementing a particular curriculum, but is in the process of revolutionizing that curriculum. In fact, Ertmer (1999, p. 47) states "in general, the more integrated one's technology use becomes the more fundamental the required changes."

[4] "Field of Dreams" refers to the film with Kevin Costner. In this film, Costner's character builds a baseball park in a corn field with the expectation that people will come once the field is built.

Still, whether a school adopts an immature or mature perspective of technology, the critical variable in the adoption and subsequent integration of a particular technology is the teacher (Fabry & Higgs, 1997; Saye, 1998). Teachers must be convinced of the feasibility of using a particular technology before this adoption and integration occurs (Office of Technology Assessment, 1995, p. 71). Teachers must perceive any possible change (technological or non-technological) as being helpful to their current duties (Saye, 1998, p. 211). Ertmer, Addison, Lane, Ross, & Woods (1999, p. 55) concur by stating, "if the computers do not teach what the teacher stresses, teaches things the teacher does not, or requires types of intelligent activity the teacher does not emphasize, it is unlikely the teacher will assign high value to its use." Quite possibly, teacher's resistance and an immature perspective towards technology could be solely dependent on teacher's acceptance. Top-down mandates will not bring about a fully technology-rich curriculum, but only teacher's individual decision and acceptance of a new technology will be the guiding force.

If it is true what Willis and Mehlinger (1996, p. 978) state as an "universal conclusion that teacher education, particularly pre-service is not preparing educators to work in a technology-enriched classroom," then we need to create the environment in which teachers can make rational decisions and accept a particular technology. In fact, Willis (1993) notes that we have moved into a new era of educational computing and a new way of asking questions about technology adoption (p. 14). We must now start asking questions about the new roles and responsibilities of a teacher and provide training to support teacher technology adoption and integration (Willis, 1993, p. 28). Fabry and Higgs (1997) note that in order to adopt a mature view of technology teachers "must also fundamentally change how they teach." (p. 388).

I take an optimistic stance and believe that we can provide an environment in which teachers can individually accept and maturely integrate technologies into their curriculums. In order to facilitate this interaction, I propose a technology bill of rights that is aimed at influencing teachers' belief system. Before this bill of rights and its principles are explicated, a summary of factors that influence and impede technology adoption, as well as a distinction between Ertmer's (1999) first- and second-order barriers must occur.

Incentives and obstacles for integrating technology

Fortunately, past research has detailed numerous incentives and obstacles towards adopting and integrating technology within schools. Table 1 summarizes these factors. Some obvious influences include tangible factors, such as additional resources, financial support, staff development, etc. Teachers need to be convinced that a particular technology will solve their problems through practical means (Cuban, 1986, p. 66). In addition to these alterations, tacit improvements need to be implemented to promote the adoption of new technologies. Some of these proposed improvements include, promoting teacher empowerment (Topp, Mortenson, & Grandgenett, 1995, p. 11); providing a comfortable atmosphere and individualized attention (Schrum & Fitzgerald, 1996); creating a comfort zone (Norum, 1997) and other similar factors. Though it may be difficult to develop a "comfort zone" for teachers using technology, these tacit changes may be more significant than providing additional resources or offering staff development technology courses. Fullan and Stiegelbauer (1991, p. 315) note that "nothing has promised so much and has been so frustratingly wasteful as the thousands of workshops and conferences that led to no significant change in practice when the teachers return to their classrooms." Fundamental technological changes could be directly linked to these tacit stimuli.

Table 1
Incentives and obstacles affecting technology adoption and integration

Incentives	**Obstacles**
• Adequate equipment and resources (Becker, 1994; Fabry & Higgs, 1997; Hadley & Sheingold, 1993; Office Of Technology Assessment, 1995; Topp, Mortenson, & Grandgenett, 1995)	• Lack of technology skills and knowledge (Martinez & Woods, 1995)
• Supportive environment that allows "risk taking" (Becker, 1994; Topp, Mortenson, & Grandgenett, 1995, p. 12; Willis, 1993)	• Lack of equipment (Ertmer, et. al., 1999)
• "Expectations and encouragement are vital to the infusion of technology into the educational process" (Topp, Mortenson, & Grandgenett , 1995, p. 13)	• Mismatch with classroom style (Ertmer, et. al., 1999)
• Collegiality among users (e.g., teachers) (Becker, 1994)	• Lack of staff development (Ertmer, et al., 1999; Fabry & Higgs, 1997; Office Of Technology Assessment, 1995; Topp, Mortenson, & Grandgenett, 1995)
• Smaller class sizes (Becker, 1994)	• Absence of incentive or improper incentives (Martinez & Woods, 1995)
• "Exemplary teachers were in schools that had nearly twice as many computer- using teachers (Becker, 1994, p. 303)	• Absence of environmental support (Martinez & Woods, 1995)
• Personal interest (Becker, 1994; Ertmer, et. al. (1999)	• Lack of motivation (Martinez & Woods, 1995)
• Extra time (Fabry & Higgs, 1997; Hadley & Sheingold, 1993; Office Of Technology Assessment, 1995; Schrum & Fitzgerald, 1996; Willis, 1993)	• Lack of equipment (Ertmer, et al., 1999)
• Staff development (Becker, 1994; Fabry & Higgs, 1997; Office Of Technology Assessment, 1995; Willis, 1993)	• Lack of time (Ertmer, et al., 1999; Office Of Technology Assessment, 1995)
• "Exemplary teachers simply had higher standards and greater perceived needs than did the other computer users." (Becker, 1994, p. 315)	• Lack of relevance (Ertmer, et al., 1999)
• Attempt to reach students with learning or attention problems (Ertmer, et. al., 1999)	• Lack of confidence (Ertmer, et al., 1999)
• Motivated to make lessons more interesting (Ertmer, et. al., 1999)	• Lack of funding (Fabry & Higgs, 1997; Office Of Technology Assessment, 1995)
• Preparing students for the future. (Ertmer, et. al., 1999)	• Lack of access (Fabry & Higgs, 1997; Office Of Technology Assessment, 1995)
• Staff support (Becker, 1994; Office Of Technology Assessment, 1995)	• "Innate dislike for change (especially change mandated from above) is the most basic and significant barrier to technology integration" (Fabry & Higgs, 1997, p. 388)
• Teachers must be empowered to make decisions about technology (Fabry & Higgs, 1997, p. 390)	• "Top down projects tend to fail over time." (Willis, 1993, p. 29)
• "Ownership is critical to success." (Willis, 1993, p. 29)	• Current assessment practices (Office Of Technology Assessment, 1995)
• "Follow up support and coaching is as essential to effective staff development as is the initial learning experience." (Office Of Technology Assessment, 1995, P. 30)	

Peggy Ertmer (Ertmer, 1999; Ertmer, et. al. 1999) distinguishes between these two factors as being first-order barriers and second-order barriers to technology. First-order barriers are external to the

particular environment, such as securing additional resources to learn more about a new technology. Second-order barriers are internal to the school setting and are related to one's beliefs about the use of technology. Second-order barriers "confront fundamental beliefs about current practice, thus leading to new goals, structures or roles" (Ertmer, 1999, p. 48). Ertmer notes that both of these barriers are prevalent in the challenges of technology adoption and both types of barriers need to be confronted simultaneously during the adoption process (Ertmer, 1999; Ertmer, et. al., 1999, p. 70). There is a distinct interplay between these first-order and second-order barriers. Ertmer, et al. (1999, p. 55) note that "researchers have suggested that teachers' beliefs about the role of technology in the classroom may either reduce or magnify the effects of first-order barriers" and that "second-order barriers may persist even when first-order barriers are removed" (p. 70). These intrinsic barriers towards technology are indefatigable since teachers' fundamental beliefs towards technology are more difficult to modify. However, the proper removal of these second-order barriers can be a critical variable in effective technology adoption. This elusive second-order barrier challenges the assumption that if a school provides enough tangible resources (e.g., money, computers, software, etc.), then teachers will be willing to use new technologies. This is not the case. Teachers' personal beliefs about using technology will greatly influence the use of a particular technology. Ertmer (1999, p. 51) notes that "reduction or elimination of first-order barriers allowed second-order barriers or issues to surface." The Office of Technology Assessment also notes that "many technology rich sites continue to struggle with how to integrate technology into the curriculum" (Office Of Technology Assessment, 1995, p. 30). Concentrating on shaping teachers' beliefs about using technology and removing these second-order beliefs is a critical variable during technology adoption and integration process.

Beliefs about technology and its impact

In fact, attitudes and beliefs in teaching are essential in understanding how a teacher teaches, thinks, and learns (Richardson, 1996 p. 102). Richardson (1996) states that teachers' beliefs are influenced by personal experience, experience with schooling and instruction, and experience with formal knowledge. Like technology barriers and influences in schools, teachers' beliefs and attitudes towards technology also have been documented in past studies. Several researchers note that teachers feel uncomfortable learning new technologies (e.g., Brush, 1998, p. 243; Ertmer, 1999, p. 48; Fabry & Higgs, 1997, p. 389; Schrum, 1999, p. 85). Willis (1993, p. 28) notes that "many educators feel isolated and alone" with the process of learning new technologies. Both Carr-Chellman and Dyer (2000) and Laffey and Musser (1998) found that pre-service teachers viewed new technologies as an impediment or contradictory to effectively teaching their students. Saye (1998) offers a typology of teachers' beliefs towards technology. Saye developed a continuum of two types of beliefs: accidental tourists and voyageurs. Accidental tourists seek to control and adapt technology within their existing teaching structure while voyageurs seek to use technology for a personal challenge and willing to explore and experiment with technology (Saye, 1998, p. 224). Saye (1998) found that most teachers were accidental tourists and tended to stay within their own teaching style.

Teachers' attitudes towards technology use potentially present a formidable obstacle. These beliefs impede viewing technology as a tool and promote an *immature* view about technology. That is to say, if a teacher feels apprehensive about using technology and views it as an impediment to interacting with students, it is no wonder that technology is being used exclusively as a supplement and within the teacher's existing teaching style. Alternatively, successful integration of technology changes educators' view of the teacher-student relationship and alters their teaching practices (Dwyer, 1996). Becker (1998) found that teachers who purported to have a constructivist teaching style, tended to integrate technology within their classroom. Teachers' willingness to change is a key variable in successful technology integration (Marcinkiewicz, 1994). Though both Becker (1994, p. 291) and Schrum (1999, p. 86) agree that with experience, teachers may eventually become comfortable with a particular technology, there is a missing, critical link in interacting with technology. This variable is teachers' vision about how technology should be utilized in their classrooms.

Cultivating a positive vision towards technology can be a significant factor in promoting a *mature* view of technology and viewing technology as a tool (Ertmer, 1999; Office Of Technology Assessment, 1995). Ertmer (1999, p. 54) states that "one of the important steps in achieving meaningful technology use is the development of a vision of how to use technology to achieve important educational goals." Ertmer (1999, p. 54) recommends three strategies to develop a vision, including modeling, reflection and

collaboration. In addition to these strategies, we need to go a step further by adopting a set of beliefs and fundamental principles. We can "jumpstart" teachers' positive experiences with technology by proposing a vision, a set of beliefs, and fundamental principles on the use of technology in the classroom. I attempt to encompass these values by proposing a technology bill of rights of educators. Exercising this bill of rights, teachers will become comfortable using technology, adopt a *mature* view of technology and start using technology as a tool in their classrooms.

Technology bill of rights for educators: Human-centered design influences

Summarized in Table 2, this proposed technology bill of rights for educators is directed towards teachers' use of technology and is intended to be a vehicle to change their existing beliefs (Ertmer's second-order barriers). A brief description of the primary influences of this proposal will be discussed before each of these rights is explicated. Human-centered design principles primarily espoused by Donald Norman (1988, 1993, 1998) is the main philosophy that influences this bill of rights. This human-centered stance proposes an attitudinal shift from a reactive stance to a more proactive stance towards using technology in the classroom. It requires designers of new technologies to consider the needs of their users as a primary factor in their creation. With this newly adopted human-centered attitude, teachers will more readily integrate "new" technologies, as well as "old" technologies into their teaching practices.

The term, "human-centered" is synonymous with terms such as "user-centered," "learner-centered." Essentially, all of these terms reflect the belief that designers must create products based upon that teachers can use and are upon their users' (or alternatively upon their learners' or human's) perspective. Software designers in particular have used this design philosophy and methodology as early as the 1970's (Eason, 1988). Donald Norman (1988, 1993, 1998) who originally coined the term, *human-centered design*, describes this methodology as a "process of product development that starts with users and their needs rather than with technology. The goal of product development is a technology that serves the user, where the technology fits the task and the complexity is that of the task not of the tool" (p. 185).

This philosophy assumes and acknowledges that there are obstacles to effective technology use. To remove these obstacles, designers can improve their technological products based upon their users' perspectives. To accomplish this, designers seek actual users react to initial prototypes in a lab setting. Designers then interpret these reactions

Table 2
Proposed human-centered technology bill of rights for educators

- It is not your fault, it is the designers' fault.
- "Old" technology is fine to use as long it is effective.
- Technology will *conform* to my proposed needs, not designer's needs.
- I am a designer of technology, rather than a user of technology.
- Appropriate technology is redundant or impractical technology is an oxymoron.
- The *sole* purpose of technology is to help me be more creative.
- It is fine to make "errors" with technology; technology will adapt to my mistakes.
- Technology is designed and used to solve *my* problems.
- The more active technology user I am, the more effective the technology will be.

and redesign their prototypes to better accommodate their users' needs. Human- centered designers are encouraged to "test early and often" (Nielsen, 1993).

Similar to Tripp and Bichelmeyer's (1990) rapid prototyping process, designers potentially could go through several iterations in gaining information about their users' perspectives. Eventually, designers will create an effective final product.

There are several assumptions about designers and users related to this design philosophy. One is that designers are serving users and their needs. Users are more proactive whereas designers need to be reactive to their users' requirements. Technology is expected to work effectively for its users and be

intuitive. If a particular technology does not work or is counter-intuitive, then it needs to be changed. The users do not need to be changed. Early participation from actual users is encouraged and promoted. Detected errors in early prototyping sessions are positive whereas early prototyping sessions that do not yield problems are suspect.

Proposed human-centered technology bill of rights

This bill of rights is written specifically for teachers and administrators to improve their attitude towards the use of new technologies. This transformation will lead these educators to successfully integrate these technologies in their curriculums and future classrooms. These nine rights are described below.

It is not your fault, it is the designers' fault: This principle addresses the "blame syndrome" in which educators and other users usually blame themselves if they cannot successfully operate a particular technology. For example, students in my online *Introduction to the Internet* course often apologize for not performing a particular task, such as properly uploading their web pages to a server. They tend to accept the blame for not being successful in this process. From a human-centered design perspective, this belief is fallacious. If a user cannot navigate properly through a particular technology, then part of (if not all) responsibility lies with the designer. Too often, educators blame themselves for doing something "wrong" with technology. They might have pushed the "wrong" button, typed in the "wrong" command, or clicked the "wrong" icon. This error points to the fact that the particular designer did not originally anticipate how we would use it. We were not "wrong", but our mental models (Johnson-Laird, 1983; Norman, 1986) of this process did not correspond to the designer's own mental model. Since we did not originally conceive of the particular technology, incongruent mental models are not our responsibility. It is true that educators need to learn how to use particular technologies (e.g., word processors) through proper training (e.g., books, workshops, etc.) and designers are not responsible for this instruction. However, if teachers cannot utilize a particular technology properly, then designers must accept this responsibility and redesign the next version to better fit their target audience's mental model.

"Old" technology is fine to use, as long it is effective. Too often, an erroneous belief is that the latest version of a software program or another technology is universally preferable to an older version or an older technology. But, this is not always the case. Sometimes an older technology (e.g., a chalkboard) may be more effective than its more recent counterpart (e.g., PowerPoint). If a teacher can teach an effective lesson using "old" technology (e.g., overhead projectors, chalkboard, slide projectors, etc.) then, it is acceptable to use. Why? Blindly jumping on the bandwagon to use the latest technology, especially if it is costly and potentially ineffective makes no sense.

This is especially true in the case of a high school in the southeast region of the United States. Recently, two high schools merged into one unified high school. This new high school was technologically upgraded with new computers and related equipment. Teachers in both schools were told not to bring any "old" technology to this new school. After a few weeks of this school merger, some teachers were requesting and searching for their "old" technology. Teachers were not totally resistant to this new environment, but they have successfully designed effective lessons with their "old" technology. The key word is effective, as well as efficient. As long as "old" technology is effective and efficient, it is acceptable to use. However, there is an amendment to this particular right. If "old" technology is not effective and/or efficient, then teachers must be willing to get rid of this "old" technology and replace it with a "new" technology.

Technology will conform to my proposed needs, not designer's needs: Notice this relationship. Who is conforming? Technology should conform to our needs as opposed our needs conforming to technology. If designers of a particular technology want to create a successful product, they must attempt to conform to our needs. This right is directly related to Donald Norman's human-centered motto for the twentieth-first century. Norman (1993) notes the 1933 Chicago World's Fair motto was: Science Finds, Industry Applies, Man Conforms. Norman proposes a twentieth-first century human-centered motto. It is: People Propose, Science Studies, Technology Conforms. This new motto now implies that we must be proactive in our expectations of new technology. If a technology is going to be successful and effective in schools, it now must conform to the needs of teachers, administrators, and students. We should expect nothing less from new or old technologies.

I am a designer of technology, rather than a user of technology: This right also represents a shift in perspective. Teachers are naturally "designers" rather than "users." They continually design new lessons, curriculum guides, instructional modules, etc. They rarely take the reactive stance of users in their profession. When interacting with technology, educators should adopt the proactive "designer" viewpoint as opposed to reactive "user" viewpoint. Wilson (1999, p. 16) concurs by stating that "end users [teachers] need to think like designers as well as consumers." As a "designer", teachers should expect that technology would enable them to be successful in their designer roles as instructors. Though they may be "using" a particular technology, teachers should continually ask how can this technology enable them to become a more effective "designers."

Appropriate technology is redundant or impractical technology is an oxymoron: This right is a potentially puzzling statement, but actually points to the specific nature of technology. As Ely (1997) notes, too often technology is referred to as an object (i.e., hardware, software). However, if one looks up the definition of technology, one realizes that technology is a process as opposed to an actual "thing." This particular right describes two qualities of this process. One aspect of technology is that it should be used for *appropriate* reasons. We must adopt the perspective that it is preposterous to think one would use technology for *inappropriate* reasons. True, it is conceivable for someone to use technology for inappropriate reasons (e.g., using a computer to add single digit numbers), but why? This proposed right implies that educators will utilize technology only for appropriate reasons. Otherwise, it is a waste of time. The second aspect of technology is the issue of practicality. The nature of technology is to solve practical problems. In fact, the nature of the field of Instructional Technology is to solve practical problems in instructional settings, as opposed to solving obtuse problems in instructional settings. Again, it would be a pointless activity if educators used technology to conceive of *impractical* solutions.

It is fine to make "errors" with technology; technology will adapt to my mistakes: This goes back to the issue of technology *conforming* to our needs. If there are "mistakes", then the next version must accommodate for these errors. If there is an error message for a particular technology or if something goes "wrong", then the responsibility falls directly on the shoulders of the designer who created this new technology. One of my colleagues has the following quote in her office: "technology teaches you patience." This adage embodies the frustration that most of us probably have experienced with current technology. I am sure that I have spent countless hours with a new technology (e.g., software program) when I could have done the same task in half of the time using another means. I was not making "mistakes", but learning to become more patient with this new technology. This right represents a reversal of roles. Instead of making an "error", we now must become more patient with the designers' ill-intended errors. We also must expect that designers will learn their mistakes and adapt their revised versions accordingly.

Technology is designed to solve my problems: This right directly equates technology as being a "tool.." In fact, if technology is not being used as a tool, then it probably is being misused. Technology is the means to provide practical solutions. The purpose of this "tool" is to solve problems. By adapting this stance, educators can make clear decisions on how to use a particular technology for a particular situation. If a technology is not going to solve a problem, then there is no reason to use it. Administrators should not expect all of their teachers to use a particular technology if it doesn't solve *their* problems. The emphasis is on selecting the right tool to solve a particular problem. This right will give a voice to those educators who do not feel compelled to join the latest technology bandwagon, but give them credence to make an informed decision in selecting the appropriate technology to solve their particular problems.

Technology is designed to help me be more creative: In addition to solving problems, educators should expect that their technology should facilitate creativity and to become more effective instructors. Thus, technology should be designed so that educators can be creative problem solvers. This is related to Norman's (1993) "smart, not dumb" concept. Norman notes that technology could either make us "smart" or "dumb". Technology could entrap us in a senseless stupor such as television viewers staying mesmerized in one spot for countless hours. Or technology could enable us to improve and illuminate our selves where students could interpret the Declaration of Independence from multiple perspectives. It is no question that we need to demand the latter option. If a particular technology does not make educators and subsequently, students "smart", then, there is no reason to use it.

The more active technology user I am, the more effective the technology will be: This is another quality of effective technology and related to the "smart" issue. Educators should expect to be active partners with a particular technology. One should not be "dormant" users and interact with a technology as a "page turner". Designers should create a dynamic environment where their users are engaged. In fact, "smart" users occur when they are engaged with a particular content area within a dynamic environment. With this expectation, educators not only will be active technology users, but their students also will be.

Technology bill of rights for educators: Summary

Each of these nine rights is deliberately directed towards influencing teachers' attitude toward technology use. If you consider the reasoning of each right, the cognitive rationale might be lacking. However, this was intended. The description and explanation of these rights resembled more of a "pep talk", sermon, or another similar affective oral exposition. The intent of these rights are to influence teachers' beliefs, introduce new principles on how to view technology, empathize with teachers' frustrations with technology, and inspire teachers to consider an alternative perspective of technology. A more comprehensive cognitive justification was consciously withheld in order to focus on influencing educators' affective domain.

With the assumption that effective technology adoption involves changing both attitudes and behaviors (Richardson, 1996), this proposed technology bill of rights is concentrated on influencing teacher's attitudes and consequently, changing teachers' behaviors toward technology. By changing one's attitude towards the use of technology within schools, teachers could potentially remove several obstacles towards effective technology adoption and integration. The proposed attitude shift, as reflected in this bill of rights, gives teachers the opportunity to take a fresh stance towards use the new technologies, adopt their own vision about technology, and gives them the opportunity to clearly distinguish whether they should adopt these technologies or not.

Future directions and a possible covenant

Another common quality of this proposed bill of rights is its tentativeness. This bill of rights is in its infancy stage and needs further input. Though based primarily upon human-centered design principles, no empirical studies have been conducted to evaluate the efficacy of these rights in changing teachers' attitudes in adopting and integrating technologies. There are obvious next steps for this type of evaluation. More research on teachers' existing attitudes towards technology could take place. A comparison of these existing attitudes and proposed attitudes espoused from this bill of rights can be made. From this comparison, a list of interventions could be created in order for teachers to potentially adopt this bill of rights in their own teaching practices. Then, the next question would be to distinguish which rights enable teachers to become effective technology adopters and integrators. Do any of these rights influence teachers' behaviors towards technology?

This is one strategy. Other similar strategies and input on this bill of rights are welcomed and encouraged. The main point is to further the discussion on encouraging effective technology integration and to encourage mature perspectives of technology amongst educators. Similar to the infancy of our own country, our national bill of rights was debated, discussed and altered. This latest bill of rights could be a catalyst for further discussions on how to promote effective technology adoption and integration within the public schools.

To create an environment of effective technology adoption and integration, we must focus on eliminating first-order technology barriers, as well as second-order technology barriers. Donald Norman's human-centered design philosophy could be a powerful tool in influencing educators' perspective towards technology. This human-centered technology bill of rights is a potential means to change the way teachers look at technology and its use in education. This bill of rights also could cause teachers to adopt a more mature view of technology. Adopting the principles outlined in this bill of rights could help educators to view technology as a tool as opposed to other immature perceptions. This bill of rights potentially could be a covenant between educators, administrators, and designers of technology. That is, a proclamation on how these individuals need to change their perspectives towards the use of technology in schools. In his examination of the adoption of twentieth century instructional technologies, Larry Cuban (1986, 1993)

notes that very little technology integration has occurred in schools, since the fundamental goals and understandings of education have not changed. Possibly, this bill of rights can be adopted by educators, administrators, designers and alter this trend.

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A CONSTRUCTIVIST MODEL OF AN ONLINE COURSE

Barbara Lewis
Barbara Spector
Ruth Burkett
University of South Florida

Background

The Web CT version of the course discussed below is the work of three people at the University of South Florida (USF). They are Barbara Spector, a professor of science education, Barbara Lewis, an instructional designer and computer expert in the Educational Outreach department, and Ruth Burkett a doctoral candidate in instructional technology. They came together 18 months ago when Barbara Lewis arrived at USF. Dr. Spector told her that a need had developed to make her science/technology/society interaction (STS) course available to students through distance learning online. Dr. Spector explicitly stated she believed it could not be done without totally ruining the course, because the course had been designed on constructivist learning theory. It had been taught over five years with several instructors in the room at one time and was highly interactive. Success depended on developing a community of co-learners among the students and the instructors and establishing an environment of trust, which she believed could not be done without consistent live contact.

Ms. Lewis said if Dr. Spector could articulate what it took to accomplish what was done in a face-to-face classroom, she could make it happen on the Web. This report attests to the fact that Ms. Lewis was right.

Assumptions about constructivism

The following are assumptions about human constructivism (Novak, 1994), the theoretical basis for the design of this course. Humans learn by building on their prior knowledge. They are not empty vessels into which we pour knowledge. Their prior knowledge is organized in a cognitive framework that influences what a person can learn and the ease with which he/she can learn it. Each person's cognitive framework is idiosyncratic and influences (a) the items to which a person will attend in his/her environment, (b) the way the person is inclined to gather and process data about those items, and (c) the Interpretation, or meaning, one makes from the data gathered. Thus the quality and quantity of knowl edge one constructs from a learning opportunity is greatly influenced by how much of a match there is between one's cognitive framework and the structure of the learning opportunities available.

Designing the Web site for constructivist learning

Building on the above understanding of constructivism, the Web site was developed for the comfort of learners regardless of the level of a person's prior knowledge or how a person was inclined to gather and process data (learning approaches). Learning approaches considered in the design included visual, auditory, or kinesthetic, sequential or global, concrete or abstract, sensing or intuitive, and interactive or reflective.

An accommodation for expected variations in prior knowledge related to STS included "just on time delivery" of supporting information to shore up students' idiosyncratic conceptual frameworks. An accommodation for varied approaches to learning was to organize resources on the Web site such that students were encouraged to make choices and determine their own learning pathways through course materials, unrestricted in time or sequence by the instructor. Additionally, students gathered data from a variety of public media sources of their choosing each week, site explorations to business and industry organizations of interest to them in the community, and informal education agencies and local schools of their choosing.

Structuring the course as an open-ended inquiry facilitated students' choices of learning pathways. The open-ended question for this inquiry was: "What is science, technology, and society interaction and its relationship to science teaching?" This format enabled each learner to begin with his/her own level of prior

knowledge, use whatever learning approach was most comfortable, work with others in the course in whatever configuration was preferred, and pursue items of interest. In these ways students were empowered to take charge of their own meaning making, the goal of human constructivism (Novak, 1994).

The combination of a person's idiosyncratic cognitive framework, preferred approach to a learning opportunity, and the personal pathways selected through the resources led to individuals making sense of data in a variety of ways. Sharing these multiple perspectives within the group enabled each learner to make more connections than he/she originally generated, thus making richer meaning and deeper understanding. Sharing these multiple perspectives and how they were derived encouraged members of the group to explore other learning approaches and additional pathways.

> Thus the course is iterative. Learners explore resources, gather data, make interpretations, share their interpretations through Web CT's forum, receive feedback from this learning community, explore more resources, reinterpret their data, and share their ideas again. The process is repeated each week as learners' make more connections to deepen the understandings they are constructing and generate their personal grounded theory of STS. While progressing through learning opportunities, they build on their own prior knowledge and experience the interactive nature of learning as they revise and improve the quality of their thinking and understanding (Spector & Burkett, 2000).

Structure of the Web site

Web CT was used as the course shell because the university provided the software and workshops for faculty as well as continuing technical support for faculty and students. This shell provided a password-protected area necessary to obtain permission for posting copyright-protected materials. The course used all of the tools available in the software package except the quiz.

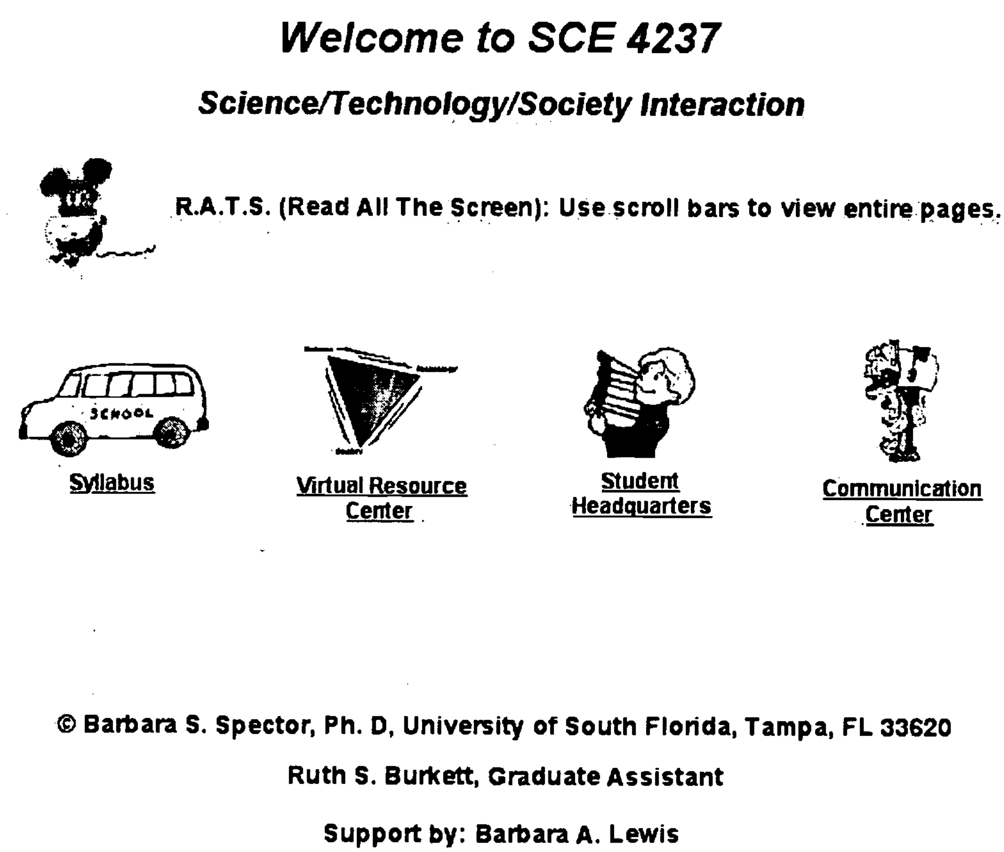

Figure 1

In this STS course the students developed awareness of science and technology as human enterprises that take place in social, environmental, and historical contexts. The course had four main pages (Figure 1) with more than 270 linked pages. A student entered the main homepage and selected the area he/she wished to explore.

The Syllabus (Figure 2) contained general information about the course. It was setup with an outline on the left for the students to click on information to view in any order or to use the navigational tools to scroll through the syllabus in sequential order. The syllabus also contained active links to enhance and fill gaps in prior knowledge. For example, if a student did not know how to create concept maps and one required learning activity asked students to develop successive concept maps of their leaning every three weeks, then the student clicked on the words "concept map" to view instructions and criteria for creating a concept map. This assignment, along with other open-ended assignments, was a vehicle for learning as well as a source of data for both self-assessment and instructor-assessment.

Syllabus

1. Syllabus
2. Course objectives
3. General Web Directions
4. Assumptions
5. Appendix A: Comparison of Paradigms
6. Content outline
   - 6.1. Nature & History of STS
   - 6.2. Examples of STS
   - 6.3. Teaching STS
7. Organization of Activities
8. Required Learning Activities
9. Grading Criteria
10. Reference Material

Science / Technology / Society Interaction
SCE4237(4 credits)
College Of Education

Syllabus Fall Semester, 2000

This is a Web Enhanced Course: For computer help telephone 974-2996

Instructor:	Dr. Barbara S. Spector
Telephone:	813-974-3533 and leave a message with the secretary including you phone number and options for when you may be reached.
Email:	WebCT email: The most reliable communication is via email: In an emergency situation only, email me at spector@tempest.coedu.usf.edu
Required Software:	Inspiration - available for purchase at the USF bookstore. To start immediately you can download the preview available in Software Helps under Student Headquarters. *Caution:* Do not wait until the 30 day trial is up to purchase the program.
Course Prerequisites:	(none)
Class meetings:	Class meetings on the Tampa Campus in EDU 313 are set for the following dates from 8:00 a.m. to 12:00 p.m.: August 29, 2000 and December 6, 2000. The class is required to meet at Sugg Middle school to participate in a two day science class. TBA.

Figure 2

The Virtual Resource Center (Figure 3) was the core of the course, the initial source of experiences from which students gathered data for investigation into STS. The center contained print matter, videotapes, graphics, interactive media, and links to relevant sites on the World Wide Web. These were arranged in three bins: (a) the Nature and History of STS, (b) specific Examples of STS, and (c) Teaching STS. The division into separate bins (categories) was artificial and arbitrary for the convenience of study (Spector & Burkett, 2000). Students were invited to explore within and among the triangles, in any order, to construct their personal theory of STS grounded in data. Questions to help the students focus their

inquiry appeared under each triangle. The icon on the left accessed readings, videos, slide presentations, Web sites, and questions focusing on the nature and history of STS. The middle icon focused on specific examples of STS relevant to humans and their quality of life. Examples ranged from individuals, to communities, to global concerns. The icon on the right focused on teaching science at middle school, high school, and higher education institutions.

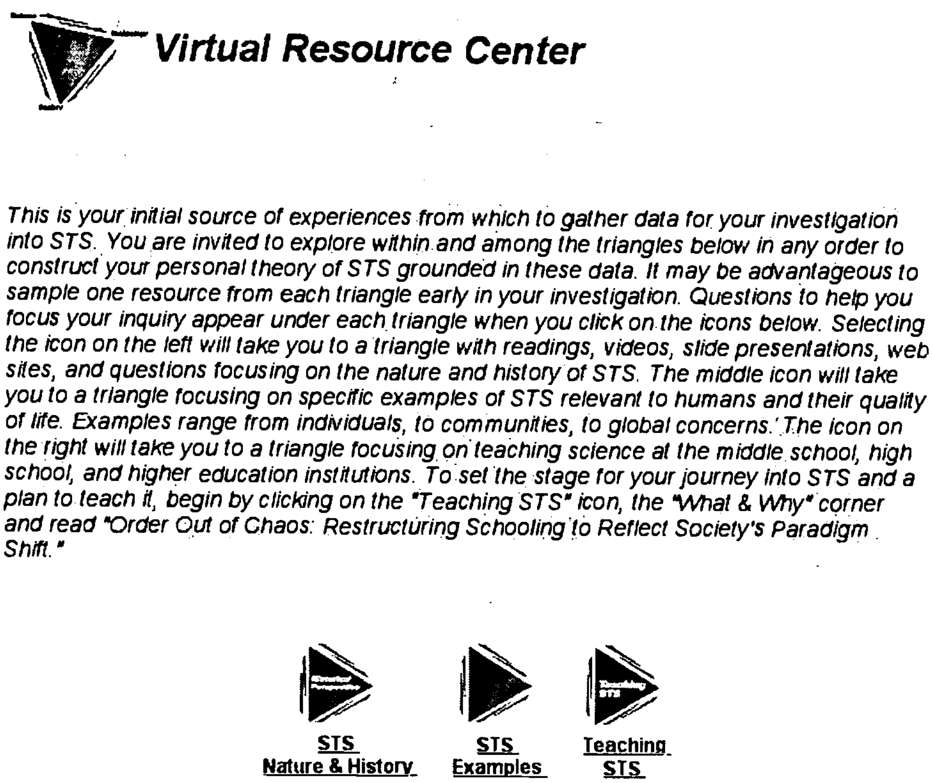

Figure 3

The Student Headquarters (Figure 4) contained (a) links to software needed to access course materials (e.g. Acrobat for print material and Media Player for video) or assist in completion of assignments (e.g. Inspiration for concept maps); (b) how-to directions for creating presentations and student home pages; and (c) other tools students found useful in their inquiry.

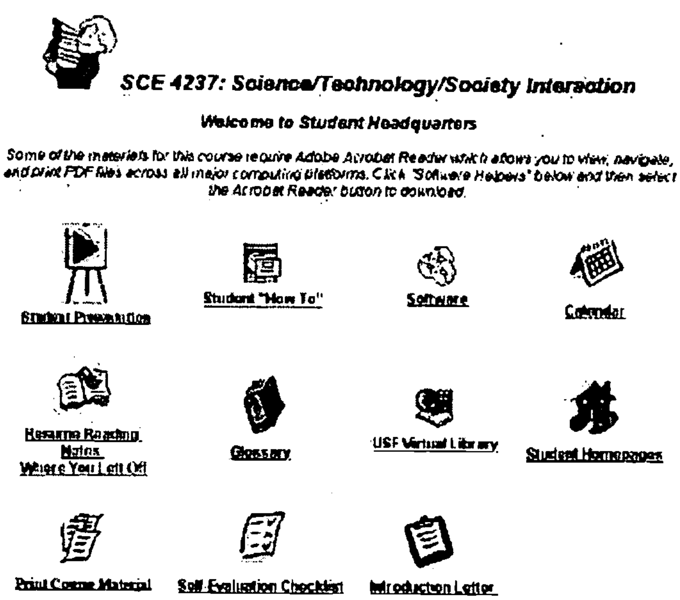

Figure 4

The Communication Center (Figure 5) facilitated the creation of a community of learners where there was shared responsibility for teaching and learning with a continuing multi-directional dialogue. This is in contrast to the traditional one-way teacher to student input or student to teacher presentation. The bulletin board forums were set up to encourage this dialogue through interaction with other students and the instructor. Reflective journals, media watches, video summaries, and other learning products were posted in the forums as stimuli for discussion. Students were required to respond to each other's postings by critiquing what was written and questioning the reasoning and evidence presented. The instructor responded similarly as a member of the community, not as the authority. Small heterogeneous study groups and groups voluntarily organized to do tasks were free to use the chat rooms built into Web CT for synchronous communication. E-mail was used on occasions when personal, one-on-one communication was needed.

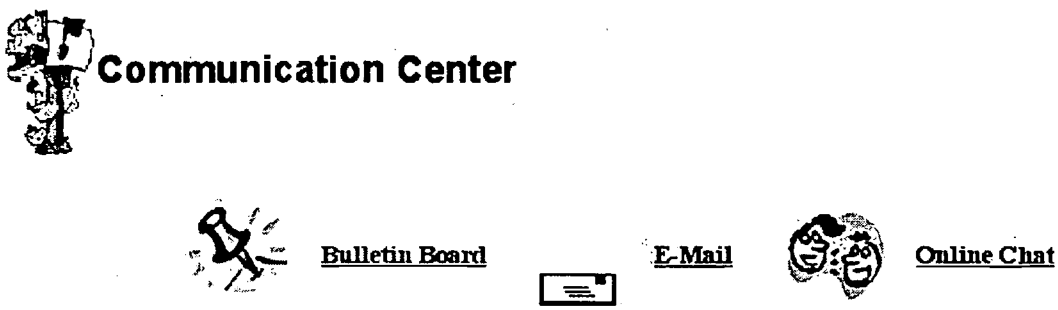

Figure 5

Conclusion

This STS course demonstrated a way to provide constructivist learning and teaching online to accommodate varied approaches to learning and differing levels of prior knowledge. The structure of this site shifted the focus from teaching, information transmitted by the teacher, to students gathering information in an on-time delivery mode as they constructed their own ideas about how science/technology/society interact. Key features that enabled this constructivist learning we re structuring the course as an open-ended inquiry, creating a virtual resource center with free access, embedding assessment in open-ended developmental instructional tasks, and fostering extensive multi-directional interaction among all members of the learning community on the bulletin board.

Preliminary findings from a study in progress indicate that a community of co-learners developed and students perceived the learning environment to be risk-free, learned to trust each other and the instructor, and participated in intellectual risk-taking leading to significant growth. Thus when placing a course online, it is feasible to maintain the integrity of a highly interactive course developed on constructivist learning theory.

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THE PROBLEM OF TRANSFER OF TRAINING APPLIED TO THE IMPLEMENTATION OF INSTRUCTIONAL SYSTEMS

Pablo Jose Riboldi
Brigham Young University

Abstract

Transfer of training has focused on learners' capability to apply what they learned to other situations outside the training setting; however, the implementation process can also be thought of as a transfer process. When teachers mediate the instruction as they implement new instruction, they have to transfer the instruction to their own students. This presentation reviews several useful concepts about transfer, such as expected transfer and elicited transfer, and then applies them to the implementation of instruction. A new theoretical construct, transfer alignment coefficient, is introduced and the practical implications of these concepts for instructional developers is explored.

Transfer of Training: Problem Definition

Transfer of training has focused on learners' capability to apply what they learned to other situations outside the training setting; however, the implementation process can also be thought of as a transfer process. When teachers mediate the instruction as they implement new instruction, they have to transfer the instruction to their own students. This presentation reviews several useful concepts about transfer and then applies them to the implementation of instruction. A new theoretical construct, transfer alignment, is introduced and the practical implications of these concepts for instructional developers is explored.

One topic from the literature which has not been traditionally associated with the topic of implementation is the problem of transfer of training (Bransford, 1979; Clark & Voogel, 1986; Cronbach & Snow, 1977; Mayer, 1980). Transfer has been defined as learners' capability to apply what they learned to other situations outside the training setting. The two kinds of transfer are:

1. *Near-transfer*. This occurs when learners' "performance reaches established criterion levels on the type of tasks and in the setting defined by the training" (Clark & Voogel, 1986).

2. *Far-transfer*. This occurs when learners are "able to apply [learned] skills in contexts that are very different than the ones encountered during training" (Clark & Voogel, 1986).

Rumelhart and Norman (1981) imply that different types of learning objectives may contribute to different transfer levels. The following types have been identified:

1. *Procedural* objectives are those that represent learning where sequences of steps are taught, procedures; for example, how to diagnose and repair an engine. Gagné (1985) calls this type of objective "intellectual skills." Once these procedures are learned, it is expected they can be applied to solve similar situations, such as diagnosing and repairing another similar engine.

2. *Declarative* objectives are those concepts and principles that are known, e.g., the principles and concepts of internal combustion engines. Gagné (1985) refers to declarative knowledge as "verbal information." Declarative knowledge is expected to be learned so that it can be generalized to solve unencountered problems, such as generalizing the principles and concepts of internal combustion engines to the science of gases.

3. *Conditional* objectives can be extrapolated as a third type of learning objective not mentioned by Clark and Voogel (1986) but identified as a kind of knowledge. Conditional objectives allow learning of when and why certain procedural or declarative knowledge should be applied. This is related to Gagné's (1985) cognitive strategies. Conditional knowledge is at the crux of far-transfer learning, knowing when and why to apply previously learned knowledge in solving unencountered problems.

4. *Experiential* objectives are those objectives that instead of specifying a certain learning outcome, they specify a certain type of experience from which students construct meaning. These type of objectives can be associated with constructivist instructional strategies.

In the opinion of Clark and Voogel (1986),

> Existing instructional design models (e.g., Reigeluth, 1983) tend to focus more effectively on near-transfer, procedural objectives, than on far-transfer, declarative [and conditional] ones. The reason for this narrow focus of instructional design models probably lies in their different theoretical origins. Most established and tested design models have been derived from behavioral learning theory. Recent models tend to owe more to the newer but more tentative cognitive learning theories. Each kind of theory proposes a different set of instructional methods to facilitate transfer. (p. 115)

Transfer received much attention from the behaviorist point of view in the first half of the 20th century (Ellis, 1965). This research focused on the identical elements model, which suggests that transfer improves as the training and application contexts approach in their similarities. Many behaviorally based studies provide evidence that generally, positive transfer increases when overall training and application conditions are similar, and the identical elements-transfer relationship is maintained across a variety of learning tasks and training-application contexts.

Criticisms of the behavioral transfer model (Bransford, 1979; Cronbach & Snow, 1977) suggest that only near-transfer is facilitated by identical elements training methods. Cronbach and Snow (1977) conducted a review of behavioral instructional research. They concluded that students with a higher general-ability were able to achieve far-transfer in these studies, but only as a consequence of their ability, and not as a result of training. Behavioral training methods, it seems, primarily tend to support near-transfer learning which does not extend to different content, or tasks for students with middle- or lower-abilities.

Behavioral methods typically include a focus on behavioral objectives that guide instruction and evaluation, instruction that directs and monitors student progress, and shorter instructional segments or frames. These instructional segments are situations where language is simplified and standardized, practice to criterion is encouraged, corrective feedback and reinforcement are given, and tests follow instruction immediately. In most cases, behavioral models seem to encourage the teaching of procedures. An example of this may be found in statistics courses that teach solution procedures rather than underlying principles and concepts.

Cognitive instructional models seem to promote far- or farther-transfer. Cognitive instructional methods include encouraging discovery strategies; suggesting the use of previously acquired and decontextualized skills through, for example, paraphrasing, advance organizers, and analogies, and an emphasis on testing the generalizability of learning. DiVesta and Peverly (1984), in one of the few studies to compare behavioral and cognitive methods for promoting transfer, showed that far-transfer was highest in the cognitive treatments of their experiment. Rumelhart and Norman (1981) have described a number of studies where analogies have provided efficient, far-transfer knowledge of new information, whereas behavioral methods seek to influence learners' overt behavior directly, cognitive methods attempt to promote the students' mental connection of new knowledge with analogous, useful, and/or meaningful prior learning. This connecting of knowledge from dissimilar contexts may be the reason for cognitive methods promoting far-transfer.

Clark and Voogel (1986) conclude that, "Based on the available evidence, it is reasonable to assume that behavioral methods promote near transfer and procedural learning; whereas, cognitive methods yield farther transfer and declarative [conditional] learning."

Transfer Alignment Coefficient: A New Theoretical Construct

Transfer research has focused on the way students apply learning elsewhere; however, the implementation process can also be thought of as a transfer process. When teachers mediate the instruction as they implement an instructional system, they transfer the information to their own students. With this perspective in mind, two related concepts—expected transfer and elicited transfer—can be defined.

Expected transfer is the type of transfer (near or far) necessary to effectively transfer different types of learning outcomes (procedural or declarative). For example, the expected transfer for a declarative learning outcome is far transfer. The more conceptual the learning objective, the farther the expected transfer would be; conversely, the more procedural the learning objective, the nearer the expected transfer would be. Figure 6describes this concept.

Elicited transfer is the type of transfer (near or far) most likely to be achieved by the type of instructional strategy (behavioral or cognitivist) the instructional system prescribes teachers to use for teaching different outcomes. For example, if the instructional system uses cognitive strategies for the teacher to teach, the elicited transfer is far. The more cognitive or constructivist the instructional strategy of

the system, the farther the elicited transfer would be; conversely, the more behavioral the instructional strategy, the nearer the elicited transfer would be. Figure 7 portrays this concept.

Therefore, *transfer alignment*, *T*, is the correlation coefficient ($-1<T<1$) between the expected and the elicited transfer per learning objective. If the instructional strategies used by the instructional system to teach different types of learning objective s elicit the same type of transfer as would be expected for the type of objective, then the transfer alignment would be strong (close to 1, aligned). If there is no relationship between the chosen instructional strategies and the type of objectives (for example, a uniform behavioral approach is used to teach all sorts of learning objectives), transfer alignment would be null (close to 0, unaligned). If the wrong strategy is used to teach the objectives or to teach the teachers how to teach these objectives (as in the case when the instructional system behaviorally prescribes for instructors how to teach cognitivist strategies to achieve cognitivist outcomes), transfer alignment would be negatively correlated (close to -1, misaligned). This is graphically depicted in Figure 8 below.

For example, if the instructional system deals with procedural learning outcomes and uses behavioral teaching methods, then teachers only need to achieve near-transfer of the instruction to their learners. The type of learning, teaching methodology, and transfer required are aligned.

On the other hand, if the instructional system deals with declarative and conditional learning outcomes but uses behavioral teaching methods, or the system behaviorally requires teachers to use cognitive methods, then teachers may only be able to achieve near-transfer of the instruction to the learners. Simultaneously, they must realize that the system is inadequate in achieving the level of far-transfer required to meet the declarative and conditional learning outcomes. There is a misalignment between the type of learning, teaching methodology, and transfer required.

Transfer Alignment, Application to Implementation

Why would transfer alignment be important? Achieving the right type of transfer is an integral part of the learning process. If learners cannot apply what they learned to other situations outside the training setting, then we cannot claim that the learning objectives have been achieved. Clark and Voogel (1986) showed that different types of transfer, near or far, are needed to learn procedural or declarative objectives and that different instructional strategies, behavioral or cognitivist, are more likely to promote different types of transfer. The better align these three are, the more likely that students will successfully transfer their knowledge. Poor transfer alignment is like hammering nails with a screwdriver.

For teachers charged with the implementation of a new instructional system, transfer alignment refers to the alignment not only between the type of learning objectives and the teaching strategy they are told to use to achieve these objectives, but also between the instructional objectives and the instructional strategy the system uses to tell the teacher how to teach. This second type of alignment may not be readily recognized and it could be ignored by instructional developers. This would be the case, for example, of an instructional system which tells teachers how to use appropriate cognitive strategies to achieve some declarative learning outcomes but it does so by prescribing teachers' behaviors. Because the use and application of cognitive instructional strategies is in itself a declarative outcome, unless teachers are taught cognitively how to use these strategies they will be unable to achieve the necessary far transfer for them to apply the strategies in their classrooms.

What effect would transfer alignment have on implementation? A positive alignment would have the effect of increasing implementation because teachers would be more likely to achieve the appropriate type of transfer as they teach with the instructional system.

This presentation explored the concepts of transfer of training including that of Transfer Alignment, alignment between learning outcomes, instructional strategies, and transfer, as applied to the implementation process. Several implication for improving the development of instructional systems were offered.

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Transfer of instructional systems

- Expected Transfer
  - The type of transfer (near or far) necessary to effectively transfer different types of learning outcomes (procedural or declarative).

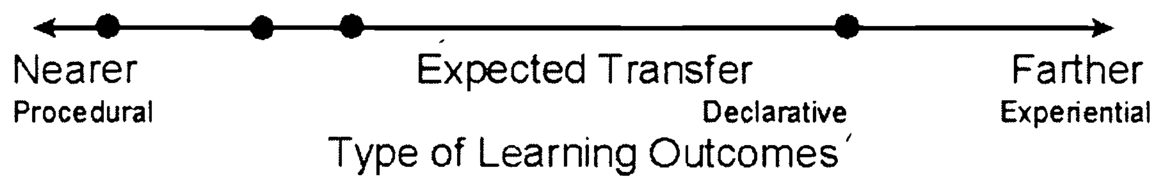

Figure 6. Expected Transfer as a the type of transfer required by the types of learning outcomes.

Transfer of instructional systems

- Elicited Transfer
  - The type of transfer (near or far) most likely to be achieved by the type of instructional strategy (behavioral or cognitivist) the instructional system prescribes teachers to use for teaching different outcomes.

Figure 7. Elicited Transfer as the type of transfer promoted by the system's instructional strategies.

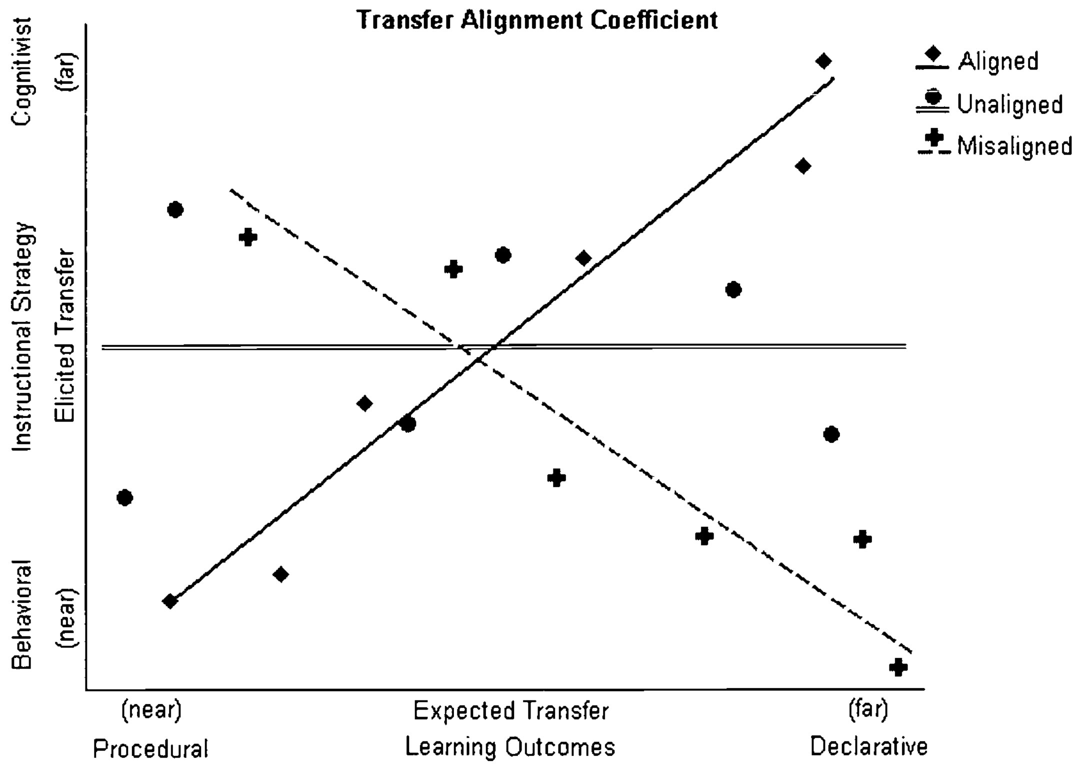

Figure 8. Transfer alignment as the correlation coefficient between expected and elicited transfer per instructional objective for three different instructional systems.

Guidelines for Instructional Sequencing in Emotional Literacy Learning-Using PATHS Curriculum as an Example

Yann-Shya Wu
Indiana University-Bloomington

Abstract

The purpose of this paper is to provide guidance for instructional sequencing in emotional literacy curricula. First, the concepts of instructional sequence and the problems involved with instructional sequence in affective domain of learning are addressed. Then, through the analysis of the emotional literacy curriculum Promoting Alternative Thinking Strategies (PATHS) as an exemplary case, general principles are inferred for instructional sequencing in emotional literacy learning. From these, principles for micro-level (within-lesson) sequencing and macro-level (curriculum) sequencing are derived. Factors influencing these sequencing principles are discussed.

1. Introduction

Within the wide range of opinions on the best way to categorize types of learning, Bloom's (1956) categorization of learning into three domains--cognitive, affective, and psychomotor- is the most widely accepted. The cognitive domain of learning "deals with the recall or recognition of knowledge and the development of understandings and intellectual abilities and skills" (Reigeluth & Moore, 1999, p. 52). The affective domain of learning "refers to components of affective development focusing on internal changes or processes, or to categories of behavior within affective education as a process or end-product" (Martin & Reigeluth, 1999, p. 486). The psychomotor domain of learning "involves athletic, manual, and other such physical skills" (Heinich, Molenda, & Russell, 1993, p. 41). Scholars, researchers, and practitioners in the educational fields have been endeavoring to design and develop curricula and instructional methods that will promote effective and efficient learning. Among these three domains of learning, cognitive learning and psychomotor learning have, up until now, received the most scholarly attention and benefited from the greatest and most sophisticated efforts in design, development, and practice. Meanwhile, comparatively little progress has been made toward designing and developing curricula and instructional methods in affective learning (Beane, 1990). Among the major reasons for this state of affairs are the currently uncertain and unclear notions of the proper definition and scope of affective learning, and a prevailing over-general approach that makes it more difficult to undertake scholarly research in this area (Bills, 1976; Beane, 1990). As a result, the affective curriculum does not fully encompass the scope of the affective domain of learning, but often emphasizes the teaching of only certain dimensions (such as the "moral"), while paying little overt attention to other dimensions (such as the "emotional").

In order to better design and develop curricula and instructional methods in the affective domain of learning, Martin & Reigeluth (1999) divide it into six dimensions: emotional development, moral development, social development, spiritual development, aesthetic development, and motivational development. Each of these six dimensions is associated with its own unique components of instructional value, such as knowledge, skills, attitudes, etc. (Definitions and associated components for each dimension are tabulated in figure 1 and figure 2.) Clearly, the fact that each of these dimensions has its own unique criteria for consideration in instructional sequencing and instructional methods poses difficulties for anyone who wishes to design instructional strategies for use within the affective learning domain. Because of space limitations, I will restrict my discussion of the reasons for this state of affairs to the latter part of this paper. The major focus of this paper will be on the question of sequencing in the development of emotional learning. This topic is very seldom discussed. However, with the recognized importance of emotional education in present day society (Goleman, 1995), there exists an urgent need to design and develop emotional literacy learning soon, so that educational methods to develop an emotionally-mature personality can be implemented starting at the early stages of childhood.

Term	Definition
Emotional Development	Understanding your own and others' feelings and affective evaluation, learning to manage those feelings, and wanting to do so.
Moral Development	Building codes of behavior and rationales for following them, including developing prosocial attitudes, often in relation to caring, justice, equality, etc.
Social Development	Building skills and attitudes for initiating and establishing interactions and maintaining relationships with others, including peers, family, coworkers, and those different form ours.
Spiritual Development	Cultivating an awareness and appreciation of one's soul and its connection with others' souls, with God, and with all His Creation.
Aesthetic Development	Acquiring an appreciation for beauty and style, including the ability to recognize and create it; commonly linked to art and music, but also includes the aesthetics if ideas.
Motivational Development	Cultivating interests and the desire to cultivate interests, based on the joy or utility they provide, including both vocational and avocational pursuits.

Fig. 1. Definitions of the dimensions of affective development (from Martin & Reigeluth, 1999, p. 494)

	COMPONENTS OF INSTRUCTIONAL VALUE			
DIMENSIONS	***Knowledge***	***Skills***	***Attitudes***	***Others?***
Emotional Development	Knowing that others experience the same emotions you do, such as joy and anger	Recognizing emotions Controlling one's emotions	I want to be happy. I don't like to be angry.	?
Moral Development	Understanding moral & ethical rules of the culture, such as caring, justice, equality	Moral reasoning skills Problem-solving skills in the realm of morals	I want to be honest. I am in favor of having ethical standards.	?
Social Development	Understanding group dynamics and democratic ideas, such as the role of a facilitator	Social skills, including interpersonal communication skills	I want to interact positively with others. I am opposed to resolving disagreements by fighting.	?
Spiritual Development	Knowledge of religious precepts about the spiritual world, such as the nature of the soul	Skills for getting in touch with your inner self Ability to love others selflessly	I want a spiritual life. I am in favor of prayer to build a relationship with God.	?
Aesthetic Development	Understanding the subjective nature of aesthetics, such as the relationship between one's values and one's judgement	Skills for assessing aesthetic qualities Skills for generating aesthetic creations	I want to surround myself with things of beauty. I appreciate an elegant theory.	?
Motivational Development	Understanding internal and external rewards for sustained activity, such as joy and sense of accomplishment	Skills for developing one's interests, both immediate and life-long	I want a career that I enjoy. I am opposed to hobbies related to guns.	?

Fig. 2. A conceptual model for affective development (from Martin & Reigeluth, 1999, p. 493)

The paper will begin with a discussion of the concept of "sequencing" as it applies to curriculum development. It will then proceed to a more detailed discussion of sequencing strategies in the emotional

literacy curriculum. In order to arrive at suggested guidelines for sequencing strategies for the emotional literacy curriculum, I will use PATHS, an emotional literacy curriculum program, as an exemplary case for analysis. After the analysis and discussion of PATHS, as well as of other literature in emotional development, I will synthesize a set of guidelines for emotional learning sequencing strategies, and explore their further implications for the design and development of emotional learning.

2.1. "Sequencing" in Curriculum and Instruction

There are several crucial decisions to make when designing and developing valid, worth-while curricula and instructional methods. These decisions include selecting educational objectives, selecting learning experiences, organizing learning experiences, and evaluating learning experiences (Tyler, 1949). Tyler goes on to cite three basic guiding criteria to be applied in the organization of learning experiences. These are: continuity, sequence, and integration. "Continuity refers to the vertical reiteration of major curriculum elements" (p. 84); "[s]equence . . . emphasizes the importance of having each successive experience build upon the preceding one but to go more broadly and deeply into the matters involved" (p. 85); "[i]ntegration refers to the horizontal relationship of curriculum experiences" (p. 85). While Tyler views these criteria as sufficient for the building of an effective scheme of organization for learning experiences, he did not provide many further guidelines for "sequencing" in subsequent discussions. Yet this aspect of learning, referring as it does to the "increasing breadth and depth of the learner's development" (p. 96), is undeniably of central importance in practical curriculum design.

According to Reigeluth (in press), "sequence," in brief, deals with "how to group and order the content." And the main factors which govern this grouping and ordering lie in the "relationships" within the content. Up to the present, there are four most popular sequencing strategies in instructional design, each is only concerned with a single type of relationship within the content. They are chronological sequence, procedural sequence, hierarchical sequence and simplifying conditions sequence. "A chronological sequence is based on the temporal order of events" (Leshin, Pollock & Reigeluth, 1992, p. 81). "A procedural sequence, ... is based upon the relationship of 'order of performance' of the steps in the procedure. A hierarchical sequence is based upon the relationship of learning prerequisites among the various skills and subskills that comprise a task. And the 'simplifying conditions' sequence is based upon the relationship of the degree of complexity of different versions of a complex task" (Reigeluth, in press).

2.2. Sequencing Strategies in Affective Learning

One thing that should be mentioned here is that these sequencing strategies are customarily applied to only two of the three domains of learning: cognitive and psychomotor learning. Sequencing strategies pertinent to affective learning have been neglected. Few researchers and writers have been willing to tackle them. Even the landmark treatise touching on affective learning, ***The Affective and Cognitive Domains: Integration for Instruction and Research***, by Martin and Briggs (1986), does not fully address "sequence" nor does it shed light on the principles and guidelines for sequencing in affective learning. However, this does not mean that "sequence" in affective learning is unimportant. On the contrary, this has been the focus of growing attention in very recent years, concerned with an increased acknowledgment of the importance of affective learning. For example, Dr. Charles M. Reigeluth in the field of instructional systems technology has been endeavoring to find valid, proven guidance for making decisions about sequencing in affective learning, with a special focus on emotional literacy learning. It is also under his encouragement and direction that the author is devoting research to this topic. The author may seem rash in making such a commitment--assuming a burden which others have thus far been reluctant to take on. There must be thorny issues in the process, so the mystery of sequencing in affective learning has not been explored. What, then, are the problem(s) or "issues" encountered in this domain?

Because of the incompleteness of the body of literature and research directly investigating the patterns of sequencing in this domain, the author undertook an analysis of an emotional literacy curriculum, ***PATHS (Promoting Alternative THinking Strategies)***, in order to infer a set of pragmatic guidelines for sequencing, and factors for influencing the sequencing. Hopefully, this data can begin to provide principles and guidelines in sequencing strategies for further design and development on affective education.

3.1. Emotional Development

"Emotional development" in short, is "Understanding [how to] control one's feelings, and learning to manage one's emotions" (Martin & Reigeluth, 1999). As stated previously, this dimension of the affective domain of learning already exists as a hidden curriculum, and has been taught implicitly.

Unfortunately this minimal curriculum design paradigm has proven incapable of meeting the demands posed by the mass of family and societal problems caused by emotional disequilibrium. The high degree of serious emotional disequilibrium in today's families and societies is surely, to some extent, a reflection of the large quantity of sad and violent crime events, emotional ineptitude, emotional abuse, desperation, and recklessness reported in any day's newspaper (Goleman, 1995). In such an environment, children are and will be the victims. As Daniel Goleman (1995), a Harvard psychologist, states, "[a] massive survey or parents and teachers shows a worldwide trend for the present generation of children to be more troubled than the last: more lonely and depressed, more angry and unruly, more nervous and prone to worry, more impulsive and aggressive" (p. xiii).

This emotional crisis has been expounded rather clearly in Goleman's popular treatise, ***Emotional Intelligence: why it can matter more than IQ*** (1995). This book, which bases its conclusions on studies of the brain's structure and function, and draws on the related fields of physiology, neurology, psychology and behavior, etc., has revealed much about how the human "emotional mind" functions and its significance in directing human behavior throughout life. Goleman points out that the factors which lead to success in life and career involve not only the Intelligence Quotient (IQ) but also a more dominant index: the Emotional Quotient (EQ). Goleman states that the emotional quotient represents self-awareness and impulse control, persistence, zeal and self-motivation, empathy and social deftness. He further indicates that an individual with higher emotional intelligence tends to have better opportunities and greater success in any field.

Research has shown that emotional development occurs ahead of cognitive development (Greenberg & Kusché, 1993). It is further suggested that EQ is not genetically determined, but can be nurtured and strengthened for years after birth by emotional literacy programs designed to enhance emotional intelligence. Goleman urged that our schools should have emotional curricula to prepare our young for successful life. He outlined several vital curricula on emotional literacy for elementary students, designed to direct them to manage their feelings and solve daily interpersonal conflicts. Among these the one most suitable for my project, and hence chosen here as a case for study, is the PATHS curriculum, developed by Greenberg, Kusché, and associates.

3.2. The PATHS Curriculum

The Purpose of PATHS

"The purposes of The PATHS Curriculum are to enhance social and emotional competence and understanding in children, as well as to develop a caring, prosocial context that facilitates educational processes in the classroom (The PATHS instructional manual, p. 1)". This is an experimental-based program initially designed for deaf children. The original title is called ***Promoting Social and Emotional Development in Deaf Children: The PATHS Project*** (Greenberg & Kusché, 1993). Since 1982 this program has been revised and expanded to meet the needs of different types of children and of multi-culture. This program is designed for kindergarten through 6. It can not only serves as a intervention program for children with physical or mental or cognitively delayed or severe behavioral disturbance or emotional problems, but also can serve as a prevention program for normal or regular or even gifted children. And this program has been successfully applied in all above different types of children.

PATHS can be effective as both a prevention and as an intervention program (Greenberg & Kusché, 1993). "These dual functions are especially of practical value to educators, since today's classrooms generally include a mixture of children who are in need of intervention as well as children who are not: at risk," but who can nevertheless benefit from prevention programs designed to reinforce healthy functioning. We have found PATHS to be useful with a variety types of children" (The PATHS instructional manual, p. 2).

Theoretical Roots

The design of PATHS takes into account aspects of diverse theories of human behavior and development. According to the authors, these theories include developmental social cognition (e.g., Greenspan [1981] and Shantz [1983]), cognitive developmental theory (e.g., Dewey [1894, 1933] and Piaget [1981]), psychoanalytic developmental psychology (e.g., Freud [1981], Nagera [1966], Pine [1985]), and attachment theory (e.g., Bowlby [1973, 1982]), interpersonal development (e.g., Selman [1980]), interpersonal problem solving (Spivak, Platt & Shure [1976]), moral development (e.g., Kohlberg [1980]), cognitive-social learning (e.g., Bandura [1986]), cognitive-behavior therapy (e.g., Kendall & Braswell [1985], Meichenbaum [1977]), Bretherton [1985], Main et al. [1985]), and so on (Greenberg & Kushé, 1993).

These above research studies have been integrated into the so-called Affective-Behavior-Cognitive-Dynamic (ABCD) theoretical model of development, which forms the foundation PATHS. The ABCD model emphasizes the dynamic relationship among affect, behavior, and cognition, integrating these three aspects so as to facilitate children's positive and healthy personality development and social functioning throughout their different developmental phases (Greenberg & Kushé, 1993).

Learning Goals

PATHS addresses the following goals in the areas of social and emotional development:

1. Increased self-control.
2. Enhanced self-esteem, self-confidence, and the ability to give and receive compliments.
3. Increased understanding and use of the vocabulary of emotions, verbal mediation, dialoguing, and interpersonal communication.
4. Improved ability to recognize and interpret the differences between feelings, behaviors, and perspectives of self and others.
5. Understanding of attributional processes that lead to an appropriate sense of self-responsibility.
6. Recognition and understanding of how one's behaviors affect others.
7. Enhanced motivation and use of creativity.
8. Increase understanding and use of logical reasoning and problem-solving vocabulary.
9. Improved knowledge of, and skill in, the steps of social problem-solving: leading to the prevention and/or resolution of problems and conflicts in daily life.

(The PATHS Instructional manual, p. 2)

These nine goals are designed to develop the child's self-control, positive self-esteem, emotional awareness and management, and interpersonal problem-solving skills. They are quite inclusive, and are consistent with the essential components of the current dominant conceptual models or frameworks for emotional intelligence. PATHS comprises one hundred and thirty-one lessons, each lesson taking about 20-30 minutes of classroom time. These lessons are classified into four major units: readiness and self-control (1 volume), feelings and relationships (3 volumes), problem-solving (1 volume), and supplementary lessons (1 volume). These units deal with five major conceptual domains: self-control, emotional understanding, building self esteem, relationships, and interpersonal problem-solving skills.

Philosophy Underlying the Goals

The philosophy intrinsic to PATHS reflects the authors' belief in educating the whole child, which is compatible with John Dewey's philosophy of wholistic education (The PATHS Instructional manual. p. 8). The wholistic approach to education entails treating language, cognition, memory, emotion, and behavior as intimately interrelated and all-important aspects of every child's personality. In accord with this philosophy, the authors affirm that

> Emotions affect all of us on a daily basis throughout our lives. Understanding and dealing with our feelings and those of others are therefore areas that will be of continual concern to all of us, whether or not we are aware of this. Understanding emotions often becomes more complex as we get older. Further, sharing emotional issues with others continues to be at least one of the major motivations for social interaction and is often the "glue" for intimacy and friendship (Youniss, 1980; Selman, 1980)." (Instructional Manual, p. 125)

Unfortunately, traditional education has emphasized the acquisition of cognitive skills much more than that of aspects of emotional cultivation, such as emotional awareness, emotional control, and so on. Thus, children have never been taught through a systematic emotional development curriculum, and teachers, more familiar with instructional methods in cognitive learning than with those for emotional learning, have less confidence in teaching emotional learning. Since PATHS provides a complete curriculum and more than one hundred lesson plans on emotional literacy for elementary school, it may offer elementary teachers a new level of confidence and comfort in thinking about wholistic education and teaching in a wholistic way.

Instructional Methods

PATHS is intended to be a separate course within the general curriculum, and is suited to the k-6 elementary years. It employs a variety of instructional methods. Because it concentrates, not on teaching cognitive skills, but rather on cultivating affect, it combines a variety of instructional methods so as to promote progressive emotional and behavioral change in the individual. These instructional methods include dialoguing, role-playing, story-telling, simulation, modeling, social and self-reinforcement,

attribution training, and verbal mediation. Visual, verbal, and kinesthetic modalities are combined to promote learning. These instructional methods are mostly intended to be conducted by the teachers; however, parents are also expected to participate in modeling outside the school environment.

The Significance of PATHS

The PATHS program has achieved improvements in several areas of children's learning. Goleman notes (1995, p. 306), that the PATHS curriculum has been successful in the following areas:

- Improvement in social cognitive skills
- Improvement in emotion, recognition, and understanding
- Better self-control
- Better planning for solving cognitive tasks
- More thinking before acting
- More effective conflict resolution
- More positive classroom atmosphere

For the purpose of this project, only the Feelings and Relationships Unit is included for investigation because it represents the major portion and thrust in emotional literacy.

4.1. Micro-Level (Within-Lesson) Sequencing Strategies in PATHS

Basically, the pattern of sequencing within each lesson of the Feelings and Relationships Unit follows seven steps set out by the developers of PATHS (PATHS, v.1, p. xxix). Figure 3 shows these seven steps (PATHS, v. 1, p. xxix), as well as an example of the script of a lesson on HAPPY (PATHS, v. 1, pp. 43-44).

Step of a Lesson	Script of a Lesson on HAPPY
1. Presenting a given emotion with a simple definition.	Happy is the way we feel when we are glad about something or when we enjoy something.
2. Showing pictures of the emotional expression.	(Take the Happy Feeling Face out of the Feelings Chart and show it to the class.) This Felling Face shows someone who is feeling happy. Do you think that happy feels comfortable or uncomfortable inside?
3. Providing examples of situations that typically elicit the feeling.	We can feel happy for a lot of reasons. There are lots of times we feel happy, like if we get to go some place we really like, if we get to play with our friends, if we get something really special, and so on.
4. Having the children talk about times when they have experienced the emotion.	Can anyone think of a time when they felt happy?
5. Modeling and labeling the feeling as a group.	Now let's look at two photographs of people who feel happy. (Point out the features that indicate happiness...Model as needed for further clarification or demonstration.)
6. Having the children make "Feeling Faces".	Now let's all practice the word HAPPY together. I want all of you to think about how you feel when you feel happy. Try to make your body feel happy and make your face look happy. Try to feel happy inside.
7. Providing the children with an activity through which the emotion can be experienced on a more personal level.	Then, while you are feeling happy, I want all of you to say the word HAPPY together. Then we will all spell it together. Then we will say it and spell it again. After that, we will say the sentence "I feel happy" together. If you need to remember how to spell the word happy, look up at the Feelings Chart or the board (or overhead) where I have written the word. Is everybody ready? Good. Let's all look and feel HAPPY and practice the word together.

Fig. 3. Seven steps of a lesson and the script.

At first glance, the seven steps of PATHS may seem superficial and oversimplified. However, by deeply pondering on these seven steps, it is apparent that they show an interesting model of sequencing of content in emotional literacy. The seven steps are converted to the following analysis (see Figure 4):

Step of Sequencing Strategies	Domain of Learning	Guideline of Sequencing Strategies

1. Presenting a given emotion with a simple definition.	1. Concept generalization. (Cognitive)	
2. Showing pictures of the emotional expression.	2. Concept classification. (Cognitive)	
3. Providing examples of situations that typically elicit the feeling.	3. Principle learning. (Cognitive)	Cognitive-to-Behavior-to-Affective
4. Having the children talk about times when they have experienced the emotion.	4. Cognitive & emotional.	External-to-Internal
5. Modeling and labeling the feeling as a group.	5. Cognitive & emotional.	
6. Having the children make "Feeling Faces".	6. Behavioral.	
7. Providing the children with an activity through which the emotion can be experienced on a more personal level.	7. Emotional & empathy.	

Fig. 4. Micro-level sequencing strategies in PATHS.

Step 1 gives a definition of one kind of emotion which seems to deal with the **concept generalization**. Pictures of facial expressions shown in step 2 depict the **concept classification**. Therefore, both these first two steps are aimed at the cognitive aspect of learning, which strives to recognize, understand and even discriminate between and among the concepts of certain feelings. In step 3, kinds of situations eliciting the feelings are shown to point out that there is a cause and effect relationship between the two. This is dealing with **principle learning**. Each of these three steps is concerned primarily with the cognitive domain of learning, which "deal[s] with the recall or recognition of knowledge and the development of understandings and intellectual abilities and skills" (Reigeluth & Moore, 1999. P. 52).

In step 4, the learners must talk about times when they have experienced the feelings already conceptualized and situated (by example). The learner is called upon to reach into his/her personal feelings and connect these concepts and practices to the actual, felt emotion. Although this is still cognitive-oriented, it goes to a deeper **emotional level of learning**.

In step 5, modeling and labeling the feelings enables learners to recognize the feeling through a cognitive-based approach. This combines the **cognitive and affective components**. In step 6, having the children make "Feeling Faces" entails asking the learners to exhibit the emotions as if they actually were feeling them. They are asked to show these feelings by their facial expressions, and further, they are asked to imagine the feelings as they do this. This requires them to emphasize the feeling **beyond the cognitive-based learning**. This combines the **behavioral and affective components (a sense of empathy)**. Step 7 deals with a specific individual situation for feedback on how each learner would react emotionally. An example would be to ask "How would you feel if your money were stolen?" This level asks the learners to internalize the situation and to simulate their own **emotional reaction**. This brings to awareness as closely as possible the feelings available to each of the learners.

In conclusion, in analyzing the seven steps of sequencing within a lesson, it becomes apparent that the within-lesson sequence is mainly structured so as to proceed from cognitive to behavioral to affective, and from external to internal through recognition, reflection and ultimately to the empathetic--(emotional)--state which is feeling. These sequencing strategies are synthesized in figure 4.

4.2. Factors Affecting Within-Lesson Sequencing Strategies in PATHS

The author has been endeavoring to uncover the rationale, or theoretical roots, embedded within the practice of the within-the-lesson sequencing strategies shown above. It has been found that the arrangement of within-lesson sequencing strategies is consistent with the following rationale and practice:

According to Kusché, Between ages five and seven, there are several changes in emotional development, including:

- the spontaneous generation of emotional concepts

- identification of anger
- understanding cause-effect relationships
- emotional perspective-taking
- recognition of emotional facial expressions
- internal-external generation of emotional concepts.

(Personal communication, November 1997)

Therefore, these steps in developmental readiness correspond to these sequencing strategies. Most of these seven steps of sequencing strategies are designed to correspond with developmental readiness. During this developmental stage, language is also believed to provide three ways to facilitate the child's behavioral and emotional control (Greenberg & Kusché, 1993, p. 77):

> "First, it serves to communicate one's internal states to others... Second, language provides an internal executive function that can mediate between impulse and behavioral action... Finally, language, and possibly other forms of symbolic representation, allow the child to become consciously aware of his or her feelings."

One method of facilitating a child's verbal and emotional control is verbal labeling of emotional states, which help the child develop powerful, new forms of self-control and self-expression.

Also between the ages of five and seven, the child's teacher, parents, and other adults play very important parts as role models, demonstrating ways of using cognitive and affective processes for managing frustration, maintaining control during times of emotional turmoil, and dealing with interpersonal conflict. This would benefit the child's emotional development and social competence.

5.1. Macro-Level Sequencing in PATHS

Macro-level sequencing analysis deals with how all the topics to be taught in the entire curriculum (i.e., here, the Feelings and Relationships Unit of PATHS) ought to be sequenced. Since the entire unit covers fifty-six lessons of several topics, it is not easy at the beginning to figure out thoroughly all kinds of sequencing to be applied, especially in an implicit way. Therefore, the author begins with the analysis of the sequencing patterns in the unit, to see if they follow in a topical or a spiral sequence. This is not an easy task because the connotations of the families of emotional feeling words are controversial, especially those which pertain to more complex feelings. Several schools of research on emotion have already created families of classifications. These share some similarities, but the differences have created some considerable controversy (Goleman, 1995). This may produce various interpretations of the sequencing at the macro-level content. Unfortunately, the developers of PATHS do not fully elaborate on the classification of families of emotions, but simply separate all feeling words into "comfortable" and "uncomfortable" feelings for the convenience of children to relate to them. Therefore, the author of this paper had to delineate less generally to achieve a more complete classification of words.

To begin classification, the author first reviewed the content of each PATHS lesson carefully to understand the meaning of the feeling words in the context of the lessons. This process helped the author to arrive at a more distinct classification of many of the words. However, the remaining words were fuzzy in personal interpretation, vague, and complex in nature. Therefore, to achieve a better approach, the author has consulted subject matter experts and academic research materials on emotions (Goleman, 1995; Ortony, Clore & Collins, 1988, p. 27). Finally, a classification figure was produced: Genera of Feelings & Relationships in PATHS (see Figure 5.). Because the Feelings and Relationships Unit covers not only feeling words but also other activities involving behavior management in the domain of emotional literacy, the classification figure extends beyond feeling words. This classification helped the author name the topic of each lesson. This made it easier for later analysis of the sequencing pattern to which lessons pertain.

Feeling	A general introduction to emotional state
Enjoyment	Happy, delighted, proud, content, satisfied
Sadness	Sad, a little down, depressed, (disappointed, hopeful), lonely
Private	Private, privacy, hiding feelings
Fine	(Fine, excited, tired)
Anger	Angry, mad, grouchy, grumpy, furious, frustrated, resentful, anger management
Fear	Afraid, (scared, safe), uneasy, terrified, nervous, (anxious, calm or relaxed)

Surprise	(surprised, expect)
Love	(Love, hate), (like, don't like), (kind, malicious), (included, rejected, excluded), generous, forgiving.
Disgust	Disgusted
Shame	Ashamed, guilty, shy, embarrassed, humiliated
Interest	(Curious, interested, bored)
Confused	(Confused, worried, sure)
Observation	Observing emotional clues in other people, observing emotional clues in ourselves
Intentionality	(Accident, on purpose)
Manner	Manner
Change Feeling	Change feeling
Jealous	Jealous or envious
Selfish	Gready, selfish
Note: ( ) denotes antonymous feelings	

Fig. 5. Genera of Feelings & Relationships in the PATHS.

The author then planed the order of each lesson to figure out the flow of the ordering of the topics. From this, a flowchart of lesson ordering was produced (see Figure 7). The flowchart illustrates several findings that are unique in this field of knowledge and will enhance further analysis of the deeper, implicit, and more complex relationships in sequencing. Later parts will have more elaboration.

5.1.1. A spiral/topical curriculum

In the flowchart, it shows that the patterns of sequencing of the topics to be taught tend to be a combination of two popular types of curriculum sequencing: spiral and topical sequencing. In topical sequencing, the "topic (or task) is taught to whatever depth of understanding (or competence) is required, before moving to the next one." (Reigeluth, 1992, p. 2.6) In spiral sequencing, several passes over the material are used to present the basics of each topic, one at a time. After the basics of each topic are taught, each topic is revisited in greater depth. In this form of sequencing, the learner "spirals" through each topic, and each topic is taught until the necessary depth is reached (Reigeluth, 1992). The following sections explain the functioning of spiral sequencing and topical sequencing within PATHS. Figure 6 synthesizes the findings.

Type of Curriculum Sequencing	Guideline of Sequencing Strategies
Spiral Sequencing	**Basic-to-complex continuum** **Hierarchical relationship**
Topical Sequencing	**General-to-detailed continuum** **Simplified conditions method** **Synonymous relationship** **Antonymous relationship**

Fig. 6. Macro-Level Sequencing.

5.1.2. Spiral curriculum

Before discussing this section, there are two important continua which need to be addressed: simple-to-complex continuum and general-to-detailed continuum. These two continua have been regarded as important components to the success of instructional sequencing. "The simple-to-complex continuum refers primarily to a continuum formed by adding or removing parts of ideas (either principle or procedures)." (Reigeluth, 1983, p. 346) "The general-to-detailed continuum refers primarily to a continuum formed by subdividing ideas (either concepts or procedures) or by lumping ideas (subordinate concepts or subordinate procedures) together. General has breadth and inclusiveness (i.e., lots of things lumped together, whereas detailed usually narrow (subdivision)" (Reigeluth, 1983, p. 344).

In the flowchart, it shows that the lesson sequence is a combination of both spiral and topical patterns of sequencing. The spiral sequencing in the flowchart is consistent with the simple-to-complex continuum. Here "simple" denotes in PATHS the so-called "basic" or "primary" feelings, such as: happiness, sadness, anger, fear, and so on. These emotions are the basis from which human beings develop other kinds of feelings through interaction with society. And there are more "sophisticated", "educated" feelings which are born from these basic feelings, and they are entitled "complex" feelings. So "complex" denotes here a blend, or variation, or nuance of feelings (Goleman, 1995). They are composed of more complex ingredients such as interpersonal skills and life experiences, and produce the complexity of guilty, selfishness, and so on. Therefore, the author would like to use "basic-to-complex" rather than simple-to-complex in this paper to avoid any misunderstanding.

Thus some lessons follow in spiral sequence, which means that the lessons which treat basic emotions are taught ahead of time. After these basic emotions have been taught, then those lessons treating complex emotions are taught. In other words, an understanding of basic emotions is treated as a prerequisite for learning about complex emotions, and it is assumed that basic emotions are the ones that complex emotions are based upon. Therefore, we may conclude that a hierarchical relationship exists here. Such basic-to-complex, hierarchical relationships can be seen clearly in Greenberg and associates' division of the fifty-six lessons in the Feelings and Relationships Unit into 4 levels of complexity (PATHS, 1994, v.1, p.xxiii-xxiiiiv). They are:

Level 1: basic and intermediate emotions (lessons 1-21)
Level 2: moderately advanced emotions (lessons 24-33)
Level 3: observations and manners of emotions (lessons 35-47)
Level 4: advanced emotions (lessons 48-54)

These 4 levels of complexity demarcate the advancement of spiral sequencing, which proceeds through topics from level 1 to 4. This unique spiral sequencing is consistent with the developmental stages of children (Greenberg & Kusché, 1993). The notions behind the framework of development is concerned with the learner as naive, possibly young, and subject to emotional, physical, and social maturation during the time of instruction.

5.1.3. Topical sequencing

Topical sequencing in the Feelings and Relationships Unit is consistent with the general-to-detailed continuum in that general feelings. For example, Lesson 3: Feeling, is broader and thus taught first, while more detailed feeling, Lesson 4: Happy, Sad and Private is taught later. A lesson of a feeling in general may be adjacent by a lesson (or lessons) of same feeling in another but different "depth." For example, lessons 35-36 teach "observing emotional clues." Lesson 35 focuses on "observing other people's emotions", but lesson 8 concerns ones' own emotions.

In topical sequencing, "intensity" of feeling links many lessons; for example, lessons 14-15 teach "fear" with an increase in intensity from "scared" to "afraid", "uneasy" to "terrified." Thus, they are sequenced according to the Simplifying Conditions Method. The Simplifying Conditions Method builds from the simplest version, instead of summarizing a topic each time (Reigeluth, in press). For example, under the topic "anger" (Lessons 7-12), each lesson contains a pure and focused dimension of the topic. Lesson 11 covers only "control of anger" and does not include other dimension, such as definitions of words related to the emotion.

Synonymous feelings are often taught together. This allows the learners a variety of expressions for the same, or similar, or synonymous feelings. This is necessary for empathetic communication of sharing feelings. The synonymous relationship occurs within one lesson or in consecutive lessons. For example, "mad" and "angry," treated as synonymous terms, are dealt with in two parts of Lesson 7.

In the macro-level of curriculum of the Feelings and Relationships Unit, feelings of antonymous relationships often are taught within one lesson or in consecutive lessons. One example is: in lesson 2, the feeling "happy" is taught, and the feeling "sad" is taught as well. Such sequencing allows the learner the opportunity, through "contrast" and "comparison" to understanding tacitly the difference between and among "feelings". This will imply a reference for learners to refer to later in life as to what "feeling' is appropriate in a given situation. This "antonymous" relationship becomes a unique characteristic in emotional literacy.

5. 2. Factors Affecting Macro-Level Sequencing

5.2.1. Spiral curriculum

As noted earlier, emotional development is restricted by developmental maturation; therefore it is not ideal to teach emotional literacy in a strict or pure sense with either spiral or topical sequencing patterns. As the flowchart shows, due to the level of developmental maturation on different stages of emotional maturation, spiral sequencing should move to a certain degree of complexity, pause, and then move on to a certain degree of detail. Therefore, the basic-to-complex continuum becomes a guiding principle in sequencing. And hierarchical sequencing become necessary when it is believed that some type of emotion should be dealt with as a prerequisite to the treatment of some other type of emotion.

5.2.2. Topical sequencing

Four guidelines are apparent in topical sequencing: a general-to-specific continuum, the Simplifying Conditions Method, synonymous sequencing, and antonymous sequencing. The nature of "intensity" in emotions and the four components of the ABCD model (affective, behavior, cognitive and dynamic) make feelings multiple-dimensional for learning. It is this implicit complexity that calls for the Simplifying Conditions Method, which calls for sequencing that builds from the simplest version, instead of summarization of a topic each time. For example, under the topic "anger" (lessons 7-12), each lesson contains a pure and focussed dimension of the topic. Another example is that lesson 11 covers only "control of anger" and does not include other dimensions, such as definitions of words related to the emotion.

Research maintains that children should learn how to express the same state or feeling with different words (Greenberg & Kusché, 1993). Maybe it is this fact about emotional learning that provides the motivation for PATHS's synonymous sequencing.

It is interesting that emotions are often contrasted along dichotomies; i.e., comfortable-uncomfortable, pleasant-unpleasant, and so forth. The reliance on dichotomies brings about a reliance on antonymous sequencing.

6. Synthesis

The findings of above analysis of sequencing in terms of micro-level lesson and macro-level curriculum in PATHS have brought out several of the principles that guide the sequencing of emotional literacy in PATHS. Figures 4 and 6 are concise syntheses of the patterns and factors influencing the instructional sequencing in PATHS. We can see that this unique curriculum draws on several sequencing strategies beyond those are used in psychomotor and cognitive learning. These unique strategies may be regarded as reflections of special factors that should be considered when emotional literacy lessons are being sequenced. Their appearance here suggests that it will not be appropriate, in curriculum design for affective learning, to simply reuse the sequencing principles proper to procedural and cognitive learning. Further guidance from research and practice should be sought in order to obtain a more comprehensive set of guidelines for emotional development education. Accordingly, instructional designers engaging in creating instructional sequencing appropriate to an emotional literacy curriculum's specific demands might wish to draw on the guidelines elaborated here.

7. Conclusion

The purpose of this paper is to provide guidance for emotional literacy learning by analyzing and synthesizing principles in the PATHS curriculum. After an introductory discussion of the concept of "sequencing" as it applies to curriculum development, it proceeds to a more detailed discussion of sequencing strategies in the affective learning domain. Then, using the PATHS program as exemplary case for analysis, it derives a set of guidelines for emotional literacy curriculum sequencing strategies, and explores their further implications for the design and development of the emotional literacy curriculum. Although the above research has dealt with only one dimension of affective learning, that of emotional development, the results also begin to illuminate the unique complexity and potential for further development of the topic of sequencing in affective learning. Affective learning is indeed a fuzzy subject, and has not yet received a clear and fully satisfactory definition. However, it is to be hoped that this author's efforts and tentative conclusions will cast sufficient light for the beginning of an extended process of disclosure concerning the issues involved with the sequencing of affective learning.

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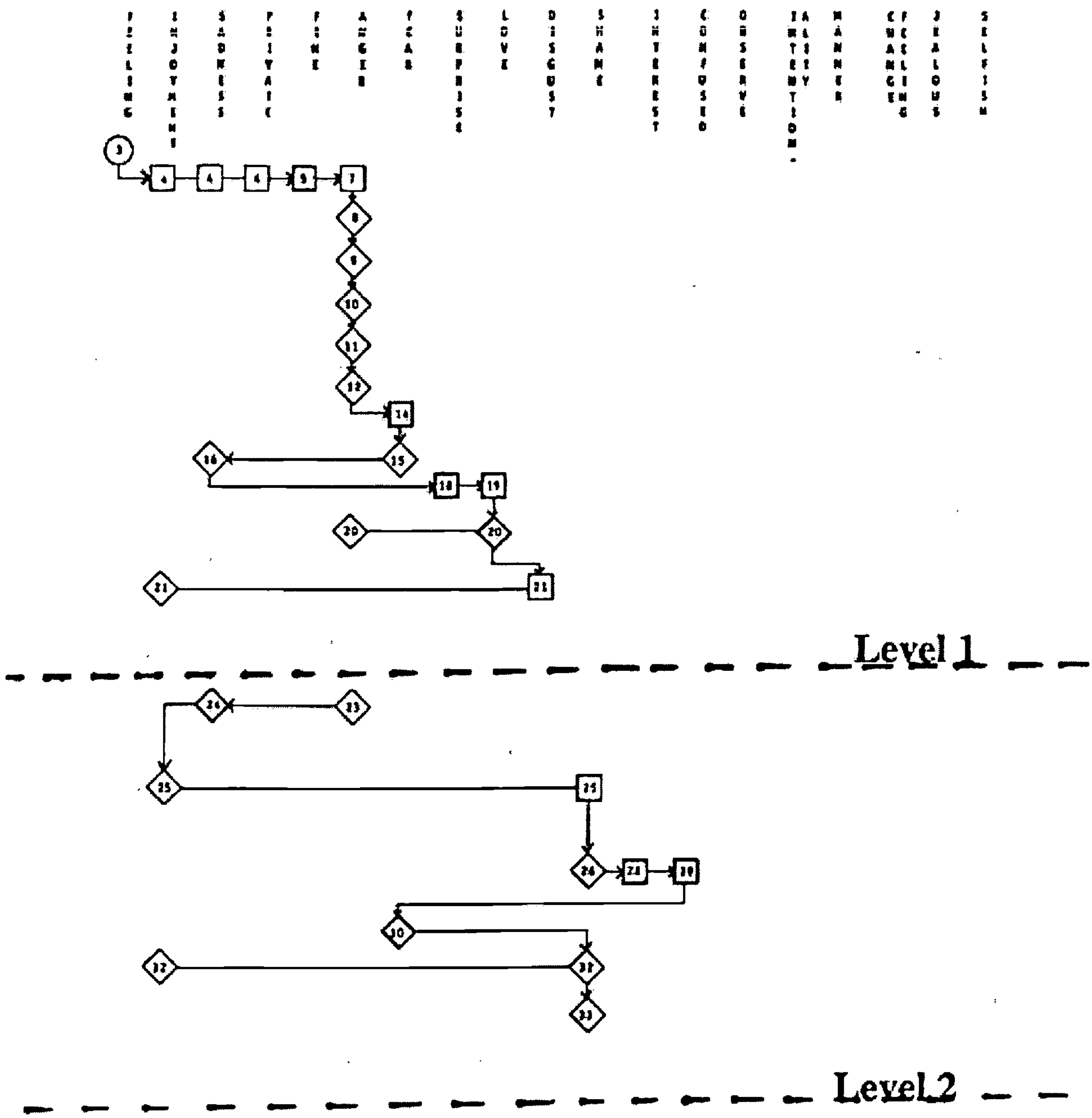
FEELING
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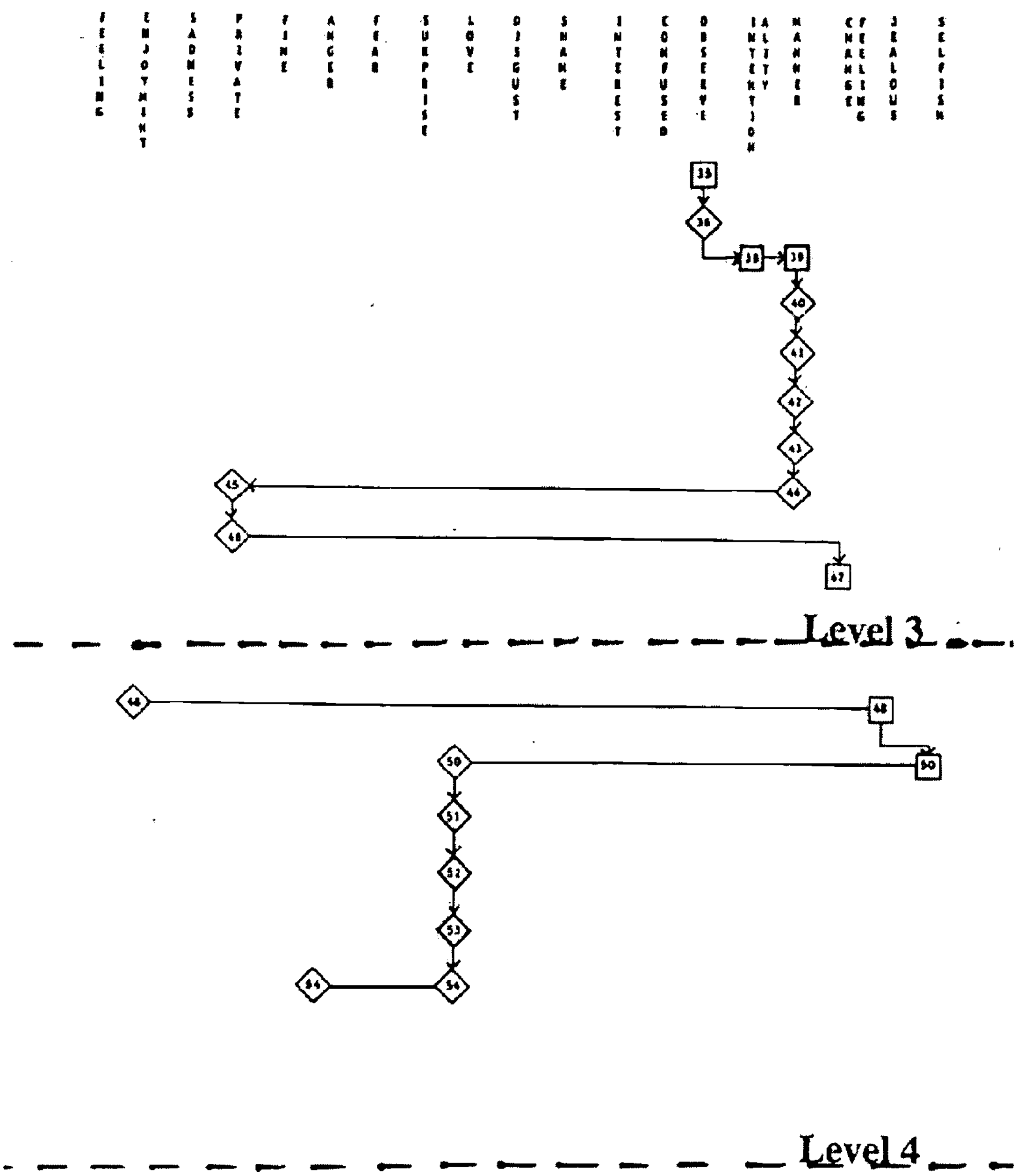

Notes:

1. Numbers indicate the lessons.
2. Missing numbers indicate non-pertinent lessons as to content.
3. ○ is the epitome of □ (in diagram).
4. □ is the epitome of ◇ (in diagram).
5. □ indicates opposite feelings put together.
6. Level 1 indicates basic and intermediate emotions.
7. Level 2 indicates moderately advanced emotions.
8. Level 3 indicates observations and manners of emotions.
9. Level 4 indicates advanced emotions.

Fig. 7. Flowchart of lesson ordering in feelings and relationship units

Simplify Web Development for Faculty and Promote Instructional Design

Dr. David C. Pedersen
Embry Riddle Aeronautical University

Faculty members are often overwhelmed with the prospect of implementing web-based instruction. In an effort to simplify the process and incorporate some basic instructional design elements, the Ed Tech Team at Embry Riddle Aeronautical University created a course template for WebCT. Utilizing rapid prototyping, the template incorporates a standardized user interface tested by students and faculty, institutional branding, structured organization, page starter templates, and online support materials.

Faculty development in the use of web based instruction is always a challenge. That challenge is multiplied exponentially when those faculty members are widely disbursed geographically. Embry Riddle Aeronautical University is unique not only in its aviation emphasis, but also in its world wide educational presence. This paper discusses the implementation of a course template to help simplify the web development process for faculty and the corresponding training issues for the Educational Technology Team.

University Profile

Founded only 22 years after the historic flight at Kitty Hawk, Embry-Riddle Aeronautical University has achieved recognition as a world leader in aviation. Each year thousands of graduates take their place in the aviation/aerospace industry as pilots, aviation managers, aerospace engineers, and other aviation professionals.

ERAU is unique not only as a pioneer in aviation, but also as a pioneer in distance education. The University has three campuses: two traditional residential campuses in Daytona Beach, FL and Prescott, AZ and an Extended Campus that is literally worldwide. The Extended Campus offers traditional courses in 120 education centers located around the world and independent study courses to students worldwide.

Instructional Technology Implementation

Because of its importance to aviation, ERAU has placed a high priority on technology implementation. For that reason, faculty members are highly motivated to make use of the web in their classes. Faculty at the residential campuses and Extended Campus education centers use the web to enhance their traditional classes. As such they need to learn how to use the web for everything from posting syllabi to electronic discussions and online testing. The independent studies courses also make use of the web to supplement and replace the traditional paper study guides and videotapes.

The Challenge

Providing faculty with the instructional technology training and support they need to utilize the web in their courses is always a challenge. At ERAU that challenge is multiplied a hundred times plus because of the 125 Extended Campus centers and the two residential campuses. The task of training 3500 faculty members is challenging enough, but when they are disbursed geographically over 127 sites the challenge becomes monumental.

Course Template

To help meet that challenge, the Educational Technology Team at the university implemented a course template for WebCT. The rationale for the template stemmed from the nearly universal reaction by faculty of being overwhelmed by the web course development process and the general failure to

incorporate instructional design into the development process. It was thought that a course template would simplify the development process by providing a standardized user interface, a structured organization, and page starter templates. In addition, good instructional design could be incorporated and encouraged.

The Template Development Process

Because of limited time and resources, a rapid prototyping approach was utilized. Existing courses were reviewed to determine what web components were being used and how they were being used. Students were surveyed regarding the usefulness of web components in their courses. From that data, faculty members who use the web were presented with several alternative web course organizational structures. They were asked for input regarding the organization and the comprehensiveness of the elements that were included. Students were then presented with several alternative user interfaces and input was collected. From the faculty and student input the alternatives were narrowed and reviewed again. A final version was determined and field-tested.

Template Components

The user interface involved the "look and feel" of the template, the elements available in the template, and the organization and structure of those elements. An important aspect of the "look and feel" was to incorporate institutional branding through the use of appropriate graphic elements. The template includes all the elements available in WebCT even though most faculty members do not use all of them. However, while all the elements are included, they are hidden from students initially requiring faculty to make a conscious decision to make them available to students. The organizational structure was developed to provide logical, efficient access to the various components.

To help jump start the development process; page templates were created for standard items such as the syllabus. The page templates are HTML files that contain a page structure with general information that can be edited by faculty members. Instructions are provided for downloading the pages, editing them, and uploading them. The inclusion of the page templates also made it possible to establish links from the course template to the HTML files for the various elements eliminating the need for faculty to create them.

Various instructional design elements were also incorporated into the template. The user interface incorporated graphic, layout, and organizational principles. The page templates incorporated page and message design principles. The primary encouragement towards instructional design elements was in the learning activity modules. Each module contained a preformatted page template for introduction, activities, conclusion, and suggestions pages. Links were provided in those pages to a site with additional information explaining the instructional design techniques that should be considered.

The template also includes a guide for faculty members on what is in the template and how to use it. In addition, there is an online, facilitated course that takes the participants through the complete course development process step-by-step. At key points, they are asked to submit portions of their work for review and feedback.

Implementation

All new WebCT courses are created using the template. Faculty members are not required to use the template. They can modify it or eliminate it and create their own. However, the template provides a starting point, especially for new faculty members.

Conclusion

A well-designed course template can simplify the development process for faculty members. It helps them focus on the instructional elements by not requiring them to make decisions about user interface and organization. It also provides them with a starting point for developing their content. The course template has helped the ERAU Ed Tech Team meet the challenge of helping faculty utilize the web for instruction.

THE AGONY AND ECSTASY OF DIGITIZING A DEPARTMENT'S FACULTY

Kenneth A. Job
Deborah Lowther
The University of Memphis

How It All Started

Over a year ago the ICL department's faculty began to express their concerns regarding the lack of technology usage in the classroom. These concerns did not related to student usage, as you would expect, but to the faculty themselves. Of particular interest was how the Internet was or was not being used to enhance instruction. Though the students are required to use various forms of technology in their class work, faculty involvement was often limited. Dr. Dennie Smith, Chair of the Instruction and Curriculum Leadership (ICL) department spearheaded the faculty's wish to increase technology usage. Though the cooperative efforts of the ICL department and the faculty of the Instructional Design and Technology (ID&T) program three major tasks were determined to improve Internet usage by the faculty.

The Tasks

- ❑ Update and enhance the current ICL web site.
- ❑ Have all members of the ICL department create and maintain an individual web page with only minimal future support.
- ❑ Involve faculty in the creation of on-line courses.

In this paper each of these three tasks are explained in the context of; what was done to achieve the task, how the faculty were involved, and what insights were found during the project.

Task I - Update and enhance the current ICL web site.

What We Did

The original ICL web site had been created several years ago, with updates being limited to just contextual changes. It was decided that the site should be reviewed and enhanced to bring it in line with more recent web site designs. Though the general appearance was to stay similar the graphics, navigation, and features of the site were to be changed. Most important was a complete review of the content of the site. Many of the text elements were outdated and in need of change, in order to reflect the latest advancements in the various ICL programs of study. The faculty also requested an expansion of the site to include; a current events calendar and on-line forms for student and faculty use.

Faculty Involvement

Once a course was determined, the project was explained to the faculty during a general staff meeting. The ICL chair impressed upon the faculty, the need to be more technologically active and how involvement in the project would be beneficial to the whole department. The faculty were asked to cooperate in the project in order to best resolve the concerns that they and the public have expressed. It was decided to select a graduate assistant (GA), who was also a doctoral student, from within the department to help coordinate the project tasks and work directly with the faculty. This person was initially introduced at that first staff meeting. Later a contact information sheet was distributed to the faculty explaining the tasks and how to contact this GA.

The first step to updating the content was to meet with each of program chairs informally. Each program; Elementary Education, Special Education, Secondary Education, Reading, Early Childhood Education, and Instructional Design &Technology had to be reviewed and the cooperation of the faculty was essential. Once informal contact was established and they understood what was required, expanded (easy to edit) copies of the web site content were distributed.

The content was reviewed by the faculty and return to the GA within 2-3 weeks on an average. The mechanical updating of the web site was completed two weeks later. The major updates and enhancements to the site were complete by the end of the first semester. Minor updates are being continued each semester as need arises.

Conclusions

Two factors were found to be of benefit in completing Task I. First, was the initial informal meeting with the program chairs. The faculty felt this meeting made them a part of the project process. That, their opinions were of value and they were going to have an impact on how the web site represented their program. Secondly, the use of expanded paper copies of the web site pages were helpful to the faculty. Instead trying to edit directly from the computer screen or use straight printed copies of the site pages, expanded versions of the pages were given to the faculty. Each web page was increased in size and given extra blank spacing for easy editing. It was necessary to explain why the expanded version was so much larger then the screen version. Once the faculty understood that it was strictly to ease the editing process and that the computer screen would look like a typical web page they found the expanded format easy to use.

Task II - Have all members of the ICL department create and maintain an individual web page with only minimal future support.

What We Did

This particular aspect of the project would be implemented over a two semester time period. During the first semester the goal was to have every faculty member of the ICL department create a personalized home page. The second semester would be used for enhancing their home pages and providing refresher instruction. The intention was that by the end of the second semester not only would all the faculty have home pages, but they would be able to maintain them with only minimal support.

Contacting the Faculty

Four stages were used to contact the faculty in order to schedule meetings for creation of their home page.

- During a faculty meeting the task was explained and the need to schedule meetings was explained. (0% response by faculty)
- A flyer containing background information on the project and contact information about the GA coordinator was sent all faculty. (20% faculty response)
- A scheduling sheet, with a series of meeting dates, was sent those who had not responded. (an increase to 80% response)
- Person - to - person scheduling, where the GA coordinator met with faculty and asked for a meeting time. (100% response by faculty)

Conclusions on Contacting the Faculty

It should be noted that between stages two and three, part of the reason for such a large increase in faculty responses was due to word of mouth. As soon as a faculty member requested a meeting they were scheduled for the earliest possible time. Once these first sessions were finished the faculty responded with praise for the work being done. As more faculty completed a session the word spread around the department and generated more interest. A second factor in scheduling was the flexibility of meeting times. When dealing with an audience like a university's faculty, who have very limited time, it was found that a wide range of meeting times was responded to favorably. Meetings could be scheduled from 8-6, M-F. Also, understanding the possible need to rescheduling with little notice needed to be considered.

Instruction on Creating, Editing and Publishing Web Pages.

Prior to meeting the faculty a series of decisions needed to be made regarding the instruction to take place.

First, what approach to uses for the instruction. Would it be One-on-One, Small / Large Group Instruction, and/or Instructional Handouts. Prior experiences using groups or handouts on campus had led to limited success, so it was decided to focus on a one-on-one approach to the instruction.

Second, was what type of software to use in creating web pages. It was decided to use Netscape's Composer for the following reasons. The university has established Netscape's software as a standard for all campus computers. Because of this no software had to be purchased or installed. The faculty would have everything they needed already on their system. Netscape's Composer component works very similar to a word processor. All members of the department have had some experience with word processing. Composer uses not HTML coding. A very positive response was expressed by the faculty to this news. Several had taken classes or had heard of HTML and disliked the idea of having to learn it.

Third, setting a time limit of 2-3 hours of instruction. Though the actual instruction times varied from 1 to 5 hours, every attempt was made to limit the instruction time for improved retention.

Fourth, was the instructional approach. Since part of the task's goal was to have the faculty maintain their pages with minimal support the following approach was used.

1. Use of pre-created template pages for a basic backbone structure, that could be expanded on.
2. The faculty member was put in the driver's seat. The instructor provided verbal instructions and avoided taking control of the mouse.
3. Repetition of key construction steps were stressed throughout the instruction. For example, the creation of e-mail links occurred three times and on three different pages.
4. Instructional fading was used as part of the learning process. As each successive repetition of a key construction step was repeated, the verbal cueing was decreased, until the faculty member was prompted to try the step alone. Reassurance was given prior this final step by restating the fact that they would be warned if something was about to go wrong.
5. Limited handouts were given, typically in the form of a 1-2 pages only. The faculty were encouraged to take their own notes.
6. Faculty were told that continued support would be available after instruction and at the convenience of the faculty.

Fifth, was determining just what was to be taught during the instructional sessions.

10. Creation and manipulation of text. Included: fonts, color, size, styles, indenting, alignment, spell checking, and use of special characters.
11. Insertion and manipulation of graphics Included: resizing, wrapping text around graphics, and borders
12. Creation of links. Including: e-mail, page-to-page, and page-to-web site links.
13. Creation and manipulation of tables. Creation of table was often left until the second semester of instruction, unless specifically requested by the faculty.
14. Publishing final pages to the university mainframe.

Dr. Joseph F. Crabtree
The University of Memphis
Instruction and Curriculum Leadership
jcrabtre@memphis.edu

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Figure 1. Example of Faculty Home Page

What We are Doing in Second Semester

The second semester of the project was focused on refresher instruction for updating faculty web pages. Individual sessions are being scheduled using the same methods used in the first semester.

Current Status

5. 15% of the faculty have updated their pages with no assistance.
6. 5% of the faculty have updated their pages with minimal assistance.
7. 45% have scheduled or at least requested assistance.
8. By the end of this semester all faculty pages are expected to be updated.

Conclusions on Web Page Instruction

The faculty responded very favorable to the one-on-one instruction and stated they found it of more value then previous instructional sessions. They also felt that by using this method of instruction more was learned and would be retained. The absence of learning HTML code was greatly appreciated. The second semester seems to be going as well as the first. So far all faculty feedback has been positive and it is expect that all of their web pages will be updated and/or expanded within the time frame.

Task III - Involve faculty in the creation of on-line courses.

What We Did

Using similar contact methods from Task II each of the department's faculty was contacted and asked if they had an interest in on-line course development. Using this list of interested faculty we began to instruct them in using CourseInfo. CourseInfo is an Internet based shell program, that allows for creation of on-line course using a relatively easy program. Currently the university is using CourseInfo for course creation , however some interest has been expressed regarding WebCT, another on-line course creation program. The instructional methods were similar to those used in Task II. Continued support has been provided to faculty to expand usage of the program.

CourseInfo and WebCT Capabilities

Some of the major features of these programs include:

- General display of textual information, like; a syllabus, instructors vitas, class handouts, and assignment materials.
- Bulletin boards
- Chat rooms
- Web page creators
- E-mail
- On-line testing
- Grouping organizers

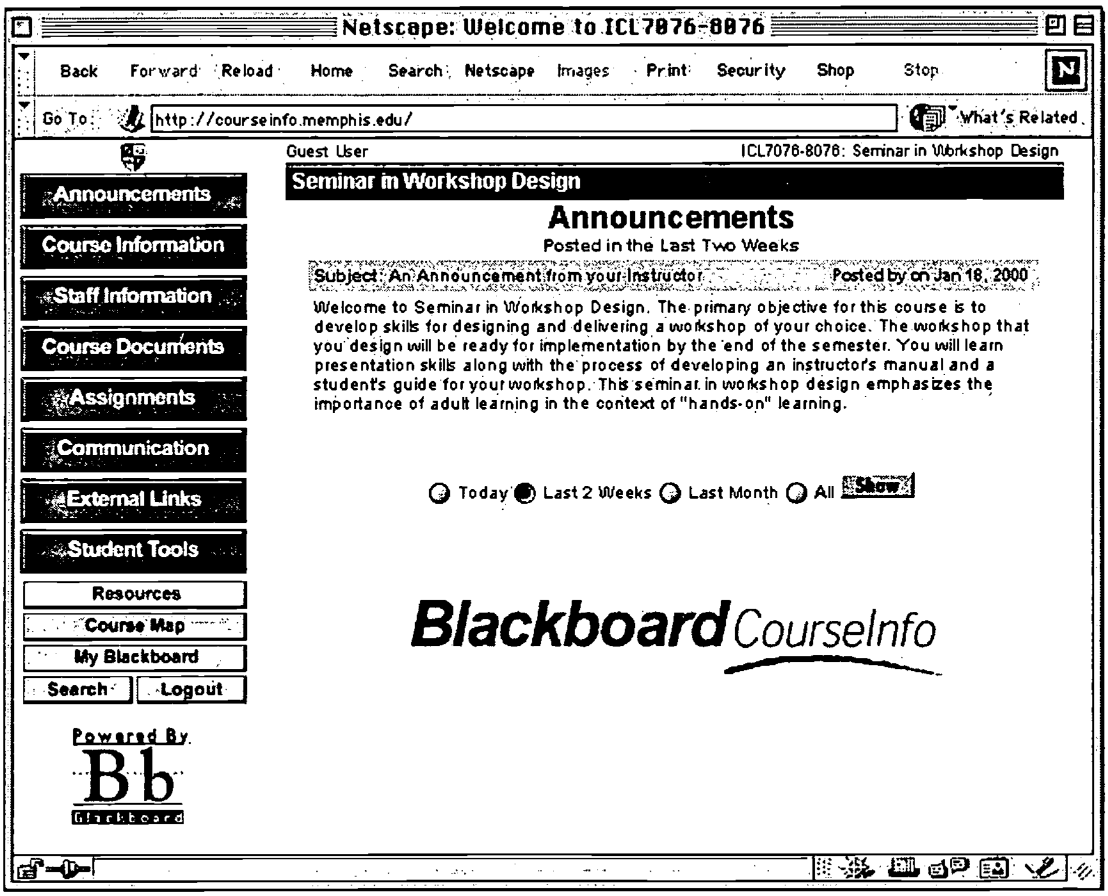

Figure 2. Example of CourseInfo Main Screen

Involvement of Faculty in the Creation of On-line Courses

Current Status

- ❑ 15% of faculty are currently using the software for on-line courses.
- ❑ Initially only 5% expressed any interest in learning an on-line course program.
- ❑ An additional 10% have express interest or are currently being instructed on the program.

- ☐ By the end of the second semester of the project, we plan to have 50% of the faculty using the on-line course program.
- ☐ Small and Large group workshops are also being offered at the university on creating on-line courses.

Conclusions Regarding On-line courses

The faculty have found on-line courses to be beneficial for the following reasons.

- The consistency of instructional materials.
- Reduction in duplicating materials.
- Increase in active participation of students.
- Promoting self-reliance among the students.
- A new dimensions to the class instruction instead of straight lecture.

In regards to the instructional method used, it should be noted that the faculty found the one-on-one instruction enabled them to learn the software program better then group sessions. However, the group sessions allowed them to express their concerns regarding the broader issues of on-line instruction among their peers. Regardless, the number of faculty interested in trying the on-line course format is increasing each semester.

Conclusion

Overall the experience of working with the faculty to improve their use of technology in the classroom has been positive. Within one year the entire department has established a web presence and nearly half have moved onto the more advanced usage of technology over the Internet. As more of the faculty become aware of the benefits, this technology can bring to the classroom, the greater the number will want to utilize it in their instruction. It is predicted that by the Summer of 2001, 80% or higher of the faculty will be using this Internet technology in their classroom.

ICL Home Page: http://www.people.memphis.edu/~coe_icl/

THE ABC'S OF ON-LINE COURSE DESIGN

Gary C. Powell, Ed.D.
Wayne State University

Abstract

During the 1997-8 academic year, 66% of the nation's 2-year and 4-year postsecondary education institutions offered distance education courses, and another 20% planned to start offering such courses (primarily via the Internet) by 2001. Currently, at least 45% of these institutions offer full college courses via the Internet. Within 20 years, on-line classes with as many as 1,000 students will replace traditional lecture courses. Distance learning is poised for a 33% annual growth over the next several years. The number of college students enrolled in distance-learning courses will reach 2.2 million in 2002. By 2002, 85% of two- and four-year colleges will offer distance-learning courses. On-line course design and facilitation is still uncharted territory for many faculty. To ensure that web-based courses are adequately developed and facilitated, we must carefully critique them. This paper presents a checklist of 25 course design principals faculty can use to critique or evaluate their on-line course sites prior to launch.

Running head: On-line Course Design

Web-based (on-line) courses are innovative approaches to distance education, where the learning and teaching process takes place via the technologies and methodologies of the World Wide Web, rather than the traditional classroom. Whether around the corner from campus or even around the world from it, an increasing number of college students are registering for classes that no longer meet in a predetermined space (e.g., a lecture hall) and time. These classes are meeting at a "distance" from the brick and mortar university campus.

Both historically and currently, the terms "distance education" or "distance learning" are applied interchangeably by many different researchers and practitioners in a great variety of settings and global locations. "Its hallmarks are the separation of teacher and learner in space and/or time, the discretionary control of learning by the student rather than the distant instructor, and noncontiguous communication between student and teacher, mediated by print or some form of technology " (Sherry, 1996).

According to a report by the National Center For Education Statistics (NCES) (1999) which collected information during the 12-month 1997–98 academic year, 66% of the nation's 2-year and 4-year postsecondary education institutions offered distance education courses, and another 20% of the institutions planned to start offering such courses within the next three years. There were an estimated 1,661,100 enrollments in all distance education courses, and 1,363,670 enrollments in college-level, credit-granting distance education courses, with most of these at the undergraduate level.

For the purposes of the NCES study, distance education refers to "education or training courses delivered to remote (off-campus) location(s) via audio, video (live or prerecorded), or computer technologies, including both synchronous and asynchronous instruction" (1999). The distance education technologies included video (two-way video with two-way audio, one-way live video, and one-way prerecorded video), audio (two-way audio transmission and one-way audio transmission), and Internet-based technologies (Internet courses using synchronous computer-based instruction such as interactive computer conferencing, and Internet courses using asynchronous computer-based instruction such as e-mail, listserves, and web-based courses). Of the institutions offering and/or planing to offer distance education in the next three years, the technology of choice was Internet-based technologies. This finding suggests that Internet technologies will be a growing mode of delivery among postsecondary institutions[5].

Another indicator of the growth of on-line Internet courses comes from forecaster William A. Draves of the Learning Resources Network, a distance learning industry group. According to Draves, within 20 years, on-line classes with as many as 1,000 students will replace traditional lecture courses on campus (Carneval, 2000). He also believes that universities should slash tuition for on-line courses to about $100 to increase access to those in lower income brackets. He does not believe that on-line education

[5] Higher education institutions are a subset of postsecondary.

will drive traditional education out of business, rather it will replace most lecture-based courses on campus. Traditional classes will cater mostly to small-group discussions.

Growth is also predicted by the International Data Corporations (IDC). "Distance learning, where student and teacher are connected by technology rather than participating in a classroom, is becoming a viable option to traditional teaching methods, and is poised for major growth [33% annually] over the next several years" (IDC, 2000). According to IDC's research, the number of college students enrolled in distance-learning courses will reach 2.2 million in 2002, up from 710,000 in 1998. The number of higher education institutions offering distance-learning programs is also growing dramatically. According to the IDC, by 2002, 85% of two-year colleges will be offering distance-learning courses, up from 58 percent in 1998. Eighty-four percent of four-year colleges will be offering distance-learning courses in 2002, up from 62% in 1998.

Despite the established base of on-line courses, on-line course design and facilitation is still uncharted territory for many college and university faculty. Many faculty members struggle with how to successfully use the available tools and technologies to organize instructional content into well-crafted teaching systems that support learning. Integrating technology into instruction remains the single most important information technology challenge confronting American colleges and universities over the next two to three years, according to data from the Campus Computing Project (1999), a national survey of information technology in US higher education. Thirty-nine percent of the institutions participating in the survey identify instructional integration as their single most significant instructional technology (IT) challenge, up from 33.2% in 1998 and 29.6% in 1997. While its been nearly a quarter of a century since the appearance of the first desktop computers on college campuses, the major challenges involve human factors – assisting students and faculty to make effective use of new technologies in ways that support teaching, learning, instruction and scholarship. Fortunately, most campuses have IT development programs (74.5%) and campus support centers (66.6%) to assist faculty in bringing technology resources into their courses. However, the report does not indicate the extent to which faculty actually avail themselves of this assistance and support.

In spite of the apparent learning curve, higher education's interest in using the Internet to provide instruction and courses steadily increases. According to the Campus Computing Project survey (1999), since 1998, the percentage of all college courses making use of electronic mail or Web resources increased 5% to 53.4% and 38.6% respectively. Twenty-eight percent of college faculty utilizes a course web page. Forty-five percent of the participants in the 1999 survey report that their institution currently offers one or more full college courses online via the Internet and the World Wide Web.

Clearly, distance education technologies -- and specifically on-line college courses -- are expanding at an extremely rapid rate. Far too often, college faculty become enamored with these technologies, and are quick to make available web-based courses (or web-enhanced traditional courses). They do so without adequately addressing the design, infrastructure or substance of their course sites, much less other underlying issues such as the new roles of teacher, site facilitator, and student in the distance learning process. Perhaps this is due to the proliferation of tools (e.g., FrontPage, Blackboard/CourseInfo) which dramatically decrease the time and effort required to create and publish web documents. Unfortunately, quick development time does not guarantee a well-crafted course site.

Course Design Principals

To ensure that web-based courses are adequately developed and facilitated in a manner that will secure and maintain student interest, motivation, satisfaction and success, we must carefully critique them prior to actually going "live". This paper will present a checklist of factors faculty can use to critique or evaluate their on-line course sites prior to launch.

Authority

Look at your web resources (e.g., links to other web sites) with a critical eye. What is the basis of the authors' authority? That is, how have they established themselves as someone with legitimate expertise in whatever area their website is about? You should first consider if the author is a well-regarded name that you recognize. If not, then you should check to see if the on-line document has some kind of bibliography, that is, a list of references used to develop the information. Next, look for the author's biography, if there is one. Is the author affiliated with an educational institution, research laboratory, governmental agency, or other reputable organization related to the topic of the document? Finally, consider e-mailing the author and tactfully ask them how they came to be an "authority" on the topic.

Bias

Bias applies to two situations here. First, make sure your text and graphics are not biased or insensitive. Are there indications of gender or racial biases and stereotyping in text or graphics? You also want to check for bias in your included web resources. Information is biased when it provides only one opinion or point of view. It is not uncommon for a web search on a particular term (such as multimedia development) to result in hundreds of "hits" consisting primarily of commercial sites or other for-profit entities. Rather than providing unbiased information – what you expect from, say, an encyclopedia – they provide words that try to persuade (e.g., advice) or sell. Check to see what organization is sponsoring the page, and follow the link to that organization if there is one. Finally, check to see if the page is actually an advertisement or opinion thinly disguised as a scholarly source of information. Many commercial sites include "white papers" or case studies that appear to be unbiased research studies, but only serve to increase sales of their product.

Citations

Have you included full citations, and in the proper format? If you post a document, such as a scanned journal article, be sure to include a full citation. See http://www.apa.org/journals/webref.html for the APA's recommended electronic reference formats.

Dates

Every credible web site includes the date it was created and the date of the last update. Also consider the date (age) of your web-resources and other posted information. Naturally, it should be current, however, you should avoid discarding seminal works just because they have an "older" publication date.

Error messages

If an error occurs, learners should be informed what the error is, why it occurred and what they can do to fix it. Communicate in the user's vocabulary. It is a good idea to utilize server software that allows you to customize the error messages. For example, if an on-line learner at Okanagan University College (http://www.onlinecourses.ouc.bc.ca/) mistypes his/her log-on ID, the error messages reads:

> "This server could not verify that you are authorized to access. Typical causes of this are you misspelled your LoginID or password, you used spaces or punctuation in your LoginID or Password, you entered your LoginID or Password in the wrong case (upper or lower) or in mixed case, you clicked on the wrong course or the wrong section of your course. Return to the Course List and try again."

Frames

Frames can be great for separating navigation components from content. Are your frames neatly arranged, or do they muck up the screen, potentially confusing the learner? Depending on which course management system you utilize, such as Blackboard/CourseInfo, you may have no choice about using frames, and likewise, an inability to provide a no-frames version of your site.

Graphics

Have you chosen the proper format for your graphics? The best rule of thumb is to use JPEG for pictures (i.e., photos) and GIF for graphics, charts, clip art, etc. Also, do not save your images with more than 256 colors and 75 DPI. Set graphics to interlacing such that they become more focused as they load. This gives the learner something to watch and is less likely to become impatient with a slow download. Finally, provide an alternative text that appears while an image is loading, when the 'show images' option on the browser is turned off, and in text-only browsers.

Help

Is "help" available for those requiring it? While we strive to create web sites that are intuitive and user friendly, we should still provide assistance for those whom require it. Include access to help on how to use the site. The help should explain what all the features, buttons, and sections of the site are. Frequently asked questions (FAQs) are valuable as well. If you have a help section or a FAQ, consider how helpful it really is.

Icons

An icon is a symbol or graphical representation of a concept, such as an image of a house representing the home page. Do the icons clearly represent what is intended to others beside you? Make sure your icons are consistent, well defined, and comprehendible (across cultures).

Join

Have you provided information on how interested students can join your class? Provide specific detail on the enrollment and registration process. Occasionally, web surfers will locate your class and want to join it; even if they are not enrolled at your university.

Keeping records

Does your site keep records of student performance? Whether records are kept in a student accessible online grade-book, or quiz scores are automatically e-mailed to you, check the functionality of these features.

Links

Check your site for links that are outdated, gone, or simply inaccurate. Are all the links clearly visible, accurately labeled and understandable? You should check your site at least once per semester for unreliable links, or what is called 'link-rot'. A reliable link, on the other hand, is up-to-date, active and does not reference a site that has moved (with no indication of the new URL). Be sure to inform learners when clicking on a link will 'surf' them off the course site to a separate website, rather than to another page on the course site. Links to documents and files should be annotated, informing learners of the type of file or information they are linking to (e.g., video, sound, text, etc.). Finally, check all links on the site for relevance and appropriateness.

Multimedia

Does the use of animation, video or audio clips contribute to the understanding of the information? Given bandwidth constraints and limitations, make sure any media you embed is really necessary. Music playing in the background of the home page is probably a 'bell & whistles' you can do without. Is file size information included for all downloadable media clips (e.g., combustion.avi [947k])? Finally, if you include streaming media on your site, be sure to either offer learners the means to choose connection speed (e.g., 28.8K, 56K, T1), or stream your media at a low data rate. This will enable those with low connection speeds to view your content.

Navigation

Learners should always be informed where they are within the hierarchy of pages on the course site, and how to get to their next destination. Check that all of the locations (e.g., pages) within the site are labeled. Have you provided clear, simple ways to get to other parts of your site? Learners will find navigation links, site maps, search mechanisms, indices and table of contents quite useful. Your first task is to provide navigation control on every page. Don't rely solely on the navigation controls in the browser. Does each page provide a way to return to the home page? Check the number of steps required for navigating from one place to another. It should be kept to a minimum. Check the length of your pages. If scrolling is necessary to read a single page (as you might expect if you placed an entire 500-line syllabus on one page), provide links within the long pages by using targets. Try to keep your navigation hierarchy as flat as practical. There should be no more than five levels and preferably fewer than three. Check for dead-ends, which are links to destinations that provide no means to return back. Finally, be sure to indicate the distance and placement of the learner within instructional sequences (e.g., page 5 of 15, page 6 of 15, etc.).

Organization

Are your online documents and other information well organized? Course management systems such as Blackboard/CourseInfo impose some organization upon you, with an area for announcements, an area for assignments, etc. The goal is to keep related information grouped in an orderly fashion. For example, one natural approach is to place different information (e.g., office hours, reading list) on separate pages, and to use proper headings within pages.

Printing

Learners may want to print all or some of your web pages. Some information is appropriate for printing and some is not. For example, a page designed to present streaming audio or video cannot be printed in a meaningful fashion because the data are not amenable to the print medium. On the other hand, text that users may want to keep as reference material is appropriate for printing. If students will want to print the web pages, which is highly likely, design them such that they format well in printed and on-screen form. To do this, be mindful of page width and length. To facilitate printing multiple pages as a collection, you should provide a means for them to do so. Simply supply a link to one long page that is comprised of all the text from the course site. This way, the print command can be issued just once.

Quick & dirty

"Quick & dirty" means cheaply made or done, or of inferior quality. Does your site look quick & dirty? Does it appear as if you created it one hour before the arrival of your first online student? Carefully check your site for misspellings, improper diction and syntax, missing data (e.g., graphics), etc.

Required plug-ins

If Java, ActiveX extensions, or plug-ins are employed, do they actually improve the site? Make sure required plug-ins or other helper applications are clearly identified, preferably right on the homepage.

Structure

Structure refers to the arrangement and organization of the elements of the course site, and the relationship of those parts to each other. In other words, how well is your site constructed? Do your web pages follow good graphic and message design principles? Do the graphics serve a function, or are they merely decorative? Are backgrounds or other visual elements distracting or cluttered? If there an element of creativity does it add to or detract from the document itself? Does the visual design enhance usability and understanding, or is it distracting? Make sure that essential instructions appear before interactive portions. Assure that all the parts of the site, such as a Flash animations, work. Is the site intuitive, or are parts likely to be misunderstood? Check the structure of the site for stability. Features should not disappear and reappear between visits. Any interactions that involve private information should be secure. How well do the features of the site work for learners with older browsers? The site design should be appealing to and appropriate for the intended audience. How long does it take for your pages to load? The pages should consistently load without problems; stability is important. Overall, your goal is for the design elements and features -- such as searchable databases, animations, graphics, sound files, and transitional pages – to enhance and not hinder the accessibility and enjoyment of the site.

Text

Does the text follow basic rules of grammar, spelling, punctuation and literary composition? Is attention paid to the needs of the disabled who often require a larger font to read the materials? Is the text concise, or does it ramble on, resulting in excessive scrolling (which should be avoided anyway)? The text should be easy to read, and not cluttered by distracting graphics, fonts, and backgrounds. Check the text for sufficient contrast, and adequate print size. Is the text, such as headings, clear and descriptive, or does it use jargon meaningful only to you?

User friendly

Does the site look and feel user friendly? Is it easy to find your way around and locate a particular page from any other page? Can the learner interact in satisfying ways? The information on the site should be easy to find and easy to use. Users should be able to maneuver around the site easily. All interactive features should be explained clearly.

Virus-free

Does your course require students to download files from the site, such as executable programs or Word documents? If so, virus scan them to assure they are clean. (Authors note: I regularly receive uploaded assignments from on-line students that have viruses, especially Word documents).

Who are you?

Your site should indicate whom you are (your name), where you work (the institution with which you are affiliated), what your credentials are (position/title), and how your students can get in touch with you (e-mail address, phone number, and mailing address). If other individuals, groups, or organizations provided assistance in the creation of your course site, make sure you give credit where credit is due. Finally, if the development of the site was funded or otherwise supported by an individual, group, or organization other than you, again, say so.

Xerox

Make sure you have a back-up (a Xerox copy and disk copy) of your web pages and other on-line material and documents. In the event lightning strikes your server, do you have a back-up of your files, or will you be 'up the creek without a paddle'?

Yo-yo effect

When viewing an instructional sequence, such as steps in a process, do learners have to repeatedly return to a higher-level page before examining the next item in what seems like a logical sequence to them? Consider a lesson on the 3 to 5 steps to change a light bulb. Rather than incorporating a logical navigational structure where the learners can click on back or forward arrows to navigate through the lesson, the yo-yo effect forces them to first return to the main menu in order to select the next task. This 'up-and-down-up-and-down' should be avoided.

Zero

Now that you've reached the end, you should have zero faults with your course site!

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THE USE OF AUDIO AND ANIMATION IN COMPUTER BASED INSTRUCTION

Carol Koroghlanian
University of Wisconsin
James D. Klein
Arizona State University

Abstract

This study investigated the effects of audio, animation and spatial ability in a computer based instructional program for biology. The program presented instructional material via text or audio with lean text and included eight instructional sequences presented either via static illustrations or animations. High school students enrolled in a biology course were blocked by spatial ability and randomly assigned to one of four treatments (Text-Static Illustration, Audio-Static Illustration, Text-Animation, Audio-Animation). The study examined the effects of instructional mode (Text vs. Audio), illustration mode (Static Illustration vs. Animation) and spatial ability (Low vs. High) on practice and posttest achievement, attitude and time.

Results for practice achievement indicated that high spatial ability participants achieved more than low spatial ability participants. Similar results for posttest achievement and spatial ability were not found. Participants in the Static Illustration treatments achieved the same as participants in the Animation treatments on both the practice and posttest. Likewise, participants in the Text treatments achieved the same as participants in the Audio treatments on both the practice and posttest.

Findings for time-in-program and time-in-instruction indicated that participants in the Animation treatments took significantly more time than participants in the Static Illustration treatments. No time differences of any type were found for participants in the Text versus Audio treatments. Implications for the design of multimedia instruction and topics for future research are included.

Introduction

Multimedia computer-based instruction (CBI) is increasingly used as an adjunct to traditional instruction in schools and corporations. CBI has typically incorporated text and graphics, but technology now exists which allows the easy and inexpensive inclusion of audio and animation into CBI programs. However, little research exists to support the notion that adding audio or animation to CBI improves learning.

Research in audio-text instruction is contradictory with some studies indicating that text plus audio is more effective than either alone (Enerson & Turney, 1984; Hartman, 1961; Lauret, 1998; Menne & Menne, 1972; Nasser & McEwen, 1976). Other studies indicate that text plus audio is not more effective than either alone (Barron & Atkins, 1994; Barron & Kysilka, 1993; Barton & Dwyer, 1987; Furnham, Gunter & Green, 1990; Nugent, 1982; Rehaag & Szabo, 1995; Van Mondfrans & Travers, 1964). These contradictory results can be explained by Paivio's dual coding theory which proposed that two separate systems are involved in cognition, one for verbal information and another for image formation (Paivio, 1986). In Paivio's view, spoken and written language are both verbal information and are encoded into verbal representations (Clark & Paivio, 1991). In terms of dual coding theory, redundant audio is single channel verbal information and would not be expected to increase learning.

Audio combined with animation is a relatively new research field that evolved from research into the effective integration of text with illustrations. Some audio-animation research has found the combination an effective technique (Lee, 1996; Mayer & Anderson, 1991; Mayer & Anderson, 1992; Mayer & Moreno, 1998; Mayer & Sims, 1994; Moreno & Mayer, 1999), while other such research has not found positive results (Childress, 1995; Lee, 1997; Palmiter & Elkerton, 1993; Wilson, 1998).

The role spatial ability plays in learners' interpretation and comprehension of animated and static graphics is unclear. Some researchers have found animation beneficial to low spatial ability learners

(Blake, 1977; Hays, 1996). Other studies have found animation more beneficial to high spatial ability learners (Hegarty & Sims, 1994; Hegarty & Steinhoff, 1997; Mayer & Sims, 1994).

The present study investigated the effects of audio, animation and spatial ability utilizing a multimedia CBI program concerning a scientific process. The major independent variables were instructional mode (text versus audio), illustration mode (static versus animated) and spatial ability (low versus high).

Instructional mode consisted of two versions, text and audio. In the text version, the instruction was presented as screen text, while in the audio version, the instruction was presented as spoken words with limited screen text. The spoken words of the audio version matched the text of the text version.

There were two versions of illustration mode, static and animated. The static version consisted of a graphic depicting the process with no visual movement to show the process in operation, while the *animated version showed the process with visual movement to demonstrate the process in operation.*

Spatial ability represented another variable in this study. All participants were classified as low or high spatial ability based on learners' scores on the Paper Folding Test (Ekstrom, French, & Harmon, 1976).

Research Questions

What is the effect of instructional mode, illustration mode and spatial ability on achievement, amount of invested mental effort and time?
Does instructional mode, illustration mode and spatial ability interact to influence achievement, amount of invested mental effort and time?

Method

Participants

One hundred and nine students from an urban high school biology course participated in this study. Participants were blocked by spatial ability and randomly assigned to one of four treatments (Text-Static Illustration, Audio-Static Illustration, Text-Animation, Audio-Animation).

Materials

A CBI program, *The Cell Cycle*, was the primary instructional material. This CBI covered mitosis and meiosis and took 40-70 minutes to complete. The CBI was based upon the objectives and content of the biology course and included information, examples, activities, practice with feedback and review. Figure 1 shows sample instructional screens for Text-Static Illustration and Audio-Static Illustration program versions.

Procedures

A spatial ability test was administered to the participants approximately one week prior to the study. Scores from all participants were ranked and median split to classify participants as high or low spatial ability. Participant assignment to each of the four treatments was counterbalanced by spatial ability. On the first day of the study, participants received instructions from the researcher and worked through the CBI program. On the second day of the study, participants completed the CBI program, an amount of invested mental effort survey and a posttest. All events occurred during normally scheduled class time.

Criterion Measures

There were three criterion measures employed in this study: an amount of invested mental effort survey, practice item results and posttest scores. En-route time data was also examined.

A 3-item Likert scaled (5 point scale from Strongly Agree to Strongly Disagree) amount of invested mental effort survey was administered prior to the posttest. This survey had a reliability of 0.57. The three items were similar to those developed by Salomon (1984) and concerned the amount of effort and concentration expended by the participants as well as how well they thought they understood the material.

Achievement was measured by a 27-item posttest. The posttest included 15 selected response and 12-constructed response items with each item worth one to three points for a total of 30 possible points. The reliability of the posttest was 0.82.

The practice items were similar in form and content to the posttest and included 17 selected response and 11-constructed response items with each item worth one to three points for a total of 30 possible points. The reliability of the practice items was 0.70.

Results

No differences in posttest achievement for instructional mode, illustration mode or spatial ability were found. The overall mean for the posttest was 17.34 (57.8%). Practice achievement differences by spatial ability were found (see Table 1). High spatial ability participants had greater achievement on practice items than low spatial ability participants. The overall mean practice score was 15.45 (51.5%).

There was a significant difference between High and Low spatial ability participants for amount of invested mental effort (see Table 2). Low spatial ability participants indicated a greater amount of invested mental effort than high spatial ability participants. The overall mean for invested mental effort was 4.04.

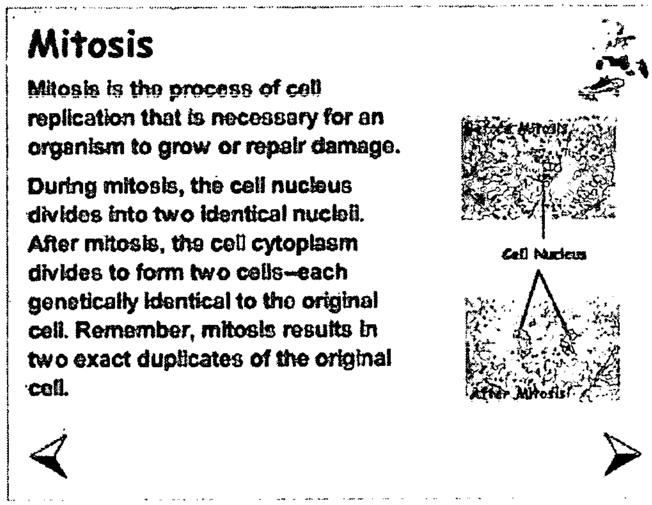
Three types of en route time data were collected. For the purposes of the study, total time-in-program was defined as the time elapsed between the participant entering and exiting the CBI program; time-in-practice was defined as the time the participants spent completing the practice items within the CBI program; and time-in-instruction was defined as the difference between total time-in-program and time-in-practice. Since the practice screens were identical in all four treatments, time-in-instruction represented the time participants spent within the treatments (Text versus Audio, Static illustration versus Animation). Time data revealed that participants spent significantly more time-in-program and time-in-instruction for illustration mode with animation taking longer than static illustration mode (see Tables 3 and 4).

Table 1. Practice Achievement Means and Standard Deviations.

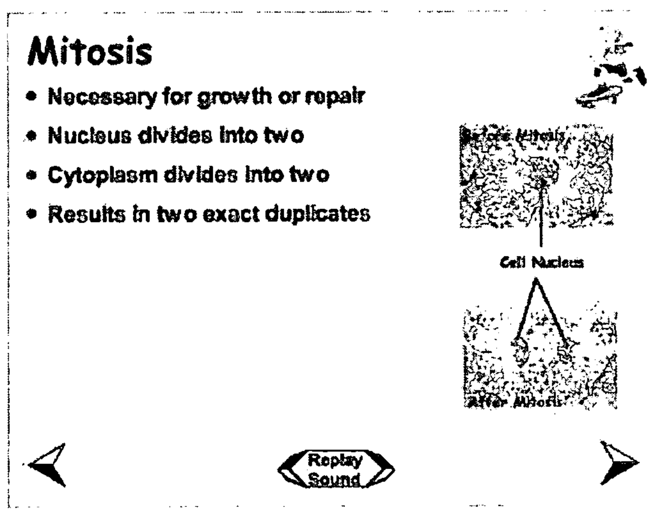
Instructional Mode		Illustration Mode		Spatial Ability	
Text		Static		Low	
M	*15.95*	*M*	15.59	*M*	14.41
SD	4.47	*SD*	4.68	*SD*	4.54
N	44	*N*	41	**N**	***41***
Audio		Animation		High	
M	14.90	*M*	15.33	*M*	16.44
SD	4.33	*SD*	4.19	*SD*	4.09
N	***40***	**N**	***43***	**N**	***43***

Table 2. Amount of Invested Mental Effort Means and Standard Deviations.

Instructional Mode		Illustration Mode		Spatial Ability	
Text		Static		Low	
M	***3.96***	*M*	3.98	*M*	4.21
SD	0.66	*SD*	0.71	*SD*	0.58
N	51	*N*	56	**N**	***50***
Audio		Animation		High	
M	4.11	*M*	4.11	*M*	3.87
SD	0.63	*SD*	0.56	*SD*	0.67
N	***52***	**N**	***47***	**N**	***53***



Text-Static Illustration Version Instructional Screen



Corresponding Audio-Static Illustration Version Instructional Screen
Figure 1. Sample Instructional Screens for Text-Static Illustration and Audio-Static Illustration program versions.

Table 3. Time-in-Program Means and Standard Deviations.

Instructional Mode		Illustration Mode		Spatial Ability	
Text		Static		Low	
M	***54.46***	*M*	50.40	*M*	53.32
SD	10.42	*SD*	11.41	*SD*	13.05
N	44	*N*	41	**N**	*37*
Audio		Animation		High	
M	51.89	*M*	56.35	*M*	53.29
SD	11.38	*SD*	9.48	*SD*	8.73
N	***36***	**N**	***39***	**N**	***43***

Note. Time-in-Program is reported in minutes.

Table 4. Time-in-Instruction Means and Standard Deviations.

Instructional Mode		Illustration Mode		Spatial Ability	
Text		Static		Low	
M	***42.51***	*M*	39.16	*M*	42.17
SD	7.67	*SD*	8.89	*SD*	10.25
N	44	*N*	41	**N**	*37*
Audio		Animation		High	
M	40.63	*M*	44.30	*M*	41.23
SD	9.32	*SD*	7.17	*SD*	6.62
N	***36***	**N**	***39***	**N**	***43***

Note. Time-in-Program is reported in minutes.

Discussion

Results for practice achievement indicated that high spatial ability participants achieved more than low spatial ability participants. These findings may best be understood in terms of dual coding theory which proposes two separate systems for cognition—verbal and visual (Paivio, 1986). Under dual coding, images such as static illustrations or animations are organized into visual representations while verbal information such as text or audio is organized into verbal representations. Referential connections are then built between the verbal and visual representations. It is thus likely that high spatial ability participants built visual representations more easily and completely than did low spatial ability participants. This allowed high spatial ability participants to invest more cognitive resources towards integrating verbal with visual information and resulted in higher practice achievement.

While results for practice achievement indicated a relationship with spatial ability, similar results for posttest achievement were not found. Both high and low spatial ability participants achieved more on the posttest than on the practice and high spatial ability participants achieved more than low spatial ability participants. However, the achievement difference between low and high spatial ability participants was not statistically significant.

One potential reason for this lack of differences in posttest achievement by spatial ability may be related to the design of the CBI program used in this study. It was designed to be instructionally effective and included instruction, interactive activities, practice with feedback and reviews. Previous studies that have investigated spatial ability and animation or animation with audio have found significant posttest achievement differences by spatial ability. However, these studies have not incorporated practice into their designs (Hays, 1996; Hegarty & Sims, 1994; Hegarty & Steinhoff, 1997; Mayer & Sims, 1994). Since the current study did include practice, it might be more appropriate to compare practice results of the current study to the posttest results of the previous studies. Viewed thusly, the difference in practice achievement found for the current study supports the findings for posttest achievement differences found by previous studies. It is also possible that the effect of practice, followed as it was in the CBI program by a review, helped low spatial ability learners compensate for their lower visualization capabilities, thus raising their scores close to those of high spatial ability learners.

Although the CBI program included elements of effective instruction, overall performance on both the practice and posttest was quite low (51.5% for the practice, 57.8% for the posttest). This was probably due to several factors. As with most science topics, the CBI program was heavily laden with the technical jargon necessary to understand the content. Considering the short time of the treatment, participants may have been unable to acquire the extensive vocabulary required by the material despite activities incorporated into the CBI to aid in learning and retaining this terminology. In addition, this course was the first high school science course for many of the participants and they may have had few existing science concepts with which they could relate new concepts. To be concise, the CBI covered a lot of material in a relatively short amount of time. It is possible, and indeed the overall achievement scores suggest, that more time and practice was necessary for participants to master the material.

Examination of the Amount of Invested Mental Effort (AIME) results indicated significant differences by spatial ability. Low spatial ability participants reported greater AIME than high spatial ability participants. This result can be explained by dual coding theory (Paivio, 1986). Low spatial ability participants probably spent more time and effort building visual representations than high spatial ability participants. The low spatial ability participants thus had fewer cognitive resources available for building the referential connections between the visual and verbal information in the CBI program (Mayer & Sims, 1994). Consequently, low spatial ability participants would naturally perceive they had expended a greater amount of mental effort than high spatial ability participants.

Findings for time-in-program and time-in-instruction indicated that participants in the Animation treatments took significantly more time (five to six minutes longer) than participants in the Static Illustration treatments. This difference was expected and supports Baek and Layne's (1988) finding that animations require more instructional time than static illustrations. In the current study, the eight Animated instructional sequences took 9 minutes and 20 seconds to play assuming no sequence was replayed by the participant. The corresponding eight Static Illustration instructional sequences should have required less time for the participants to complete as they need not have waited for an animation to finish before proceeding. In contrast, no difference in terms of time-in-practice was found. Participants in the Animation treatments spent the same amount of time-in-practice as participants in the Static Illustration treatments. Since the practice screens contained only static illustrations or no illustrations at all, this result was expected.

No time differences of any type were found for participants in the Text versus Audio treatments. Again, differences for time-in-practice were not anticipated since the practice screens were the same in the Text as in the Audio versions. However, the results for time-in-program and time-in-instruction are puzzling.

Participants spent the same amount of time in the Text as in the Audio treatments. Based on previous studies (Barron & Kysilka, 1993; Koroghlanian & Sullivan, 2000) and common sense, one would have expected the Audio version to take longer than the Text. Examination of data collected during CBI program development indicates that participants in the Text versions should have completed the CBI program 10 to 15 minutes sooner than those in the Audio versions. This time difference did not occur. Perhaps participants in the Text versions spent those 10 to 15 minutes rereading the text, examining the static illustration/animation or trying to integrate the text information with the static illustration/animation.

Implications for Instructional Design

The results of this study supports previous research that suggests moving some text from the screen to audio neither hinders nor improves learning. This finding has important implications for multimedia development. If screen "real estate" is needed for something other than instructional text, which is especially true for simulations and concepts difficult to explain with words alone, then text can be moved from the screen to audio with no loss in achievement. This is an important and useful instructional technique for instructional designers to consider, especially when designing materials with scientific or technical content.

The implications of this study are less straightforward in terms of animation. Animation did not improve learning for this content and age group. Animation did take more instructional time than static illustrations with no corresponding improvement in achievement or difference in attitude. Whether to include animation or not in multimedia programs or CBI is still a matter of instinct, not research, and the final decision may be dictated by pragmatic concerns such as budget or time.

While this study was conducted with computer based instructional materials; the results have wider implications for multimedia instruction in general. Web based instruction, for example, increasingly incorporates multimedia attributes such as audio and animation. The incorporation of these attributes should be based on instructional design principles and research to ensure effective and efficient instruction.

Suggestions for Future Research

Several avenues of future research are suggested by the findings of this study. One area that warrants further investigation is the physical combination of audio and animation. Some researchers might argue that the present study did not minimize the split attention effect and thereby did not optimize the instruction or research conditions. Future research could examine superimposing text on the illustrations and animations as well as utilizing audio only with illustrations or animations followed by text at the end of the sequence. These sequencing and layout situations would tend to minimize the split attention effect and might clarify research results and subsequent instructional design decision-making.

One puzzling and fascinating result of the present study concerns the activities and mental processes of the participants. Participants spent the same amount of time in the Text as in the Audio versions although participants in the Text version would have been expected to finish 10-15 minutes sooner than those in the Audio version. Interposing questions during the instruction or formally observing participants might provide information of use and interest to the researcher and instructional designer.

Further research into text density and structure would be valuable to instructional designers designing both traditional CBI and web-based instruction. Reducing instructional screen text while providing the majority of instruction via an audio track, is an extremely useful technique in situations of highly complex processes and simulations where there is a need to maximize screen space for non-text purposes. Research into the amount of text required when text is combined with audio and the manner in which that text should be structured and presented warrants further investigation.

Audio and animation are powerful tools for the instructional designer. Deciding when and how to use these tools is an important field of inquiry that deserves more attention and effort.

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VIDEO-BASED CLASSROOM
LESSONS FROM DELIVERING INSTRUCTION IN AN INTERACTIVE VIDEO-BASED CLASSROOM

Trey Martindale
University of West Florida

Abstract

Distance education is growing very rapidly, and one form of distance education is two-way interactive video. This qualitative pilot study presents findings from interviews conducted with instructors who taught in a new interactive video classroom. Instructor responses are condensed and summarized. Responses include instructor insights on: student perceptions; instructor skills required; teaching methods used; obstacles to overcome; and technical considerations.

Lessons from Delivering Instruction In an Interactive Video-Based Classroom

In the last few years of the 20th century institutions of higher education have moved toward delivering instruction via distance education -- the separation of the instructor and learner by time and/or location. While distance education is not a new phenomenon, the decreasing cost and subsequent ubiquity of telecommunications equipment, computers, and networks has made distance education a more attractive option. This option may appear favorable to innovative instructors, fiscally conscious administrators, and students who cannot attend a residential campus (Moore and Kearsley, 1996). The opportunity to reach new educational "markets" has encouraged higher education institutions to pursue various modes of distance delivery. One such delivery mode involves two-way interactive compressed video. This pilot study will describe instructor obstacles, insights, and lessons learned from course delivery in an interactive two-way video environment.

Program History and Description

In 1998 the University of West Florida began course delivery via two-way interactive video. The University constructed two classrooms -- one at the main campus and one at a branch campus 75 miles away. These classrooms were equipped with VTEL video cameras, microphones, and telecommunications equipment to enable two-way transmission of real-time compressed video and audio signals. This system was meant to replace the practice of instructors commuting to and from the main and branch campuses for teaching, advising, and related student support services. The student population at branch campus was growing, with an increasing demand for courses and degree programs. Table 1 shows a chronology of significant developmental events.

Table 1

1993 UWF Instructional Technology department seeks funds for video-based classroom
1997 Main and branch classrooms constructed and connected
1998 Video-based course delivery begins
1999 Web-based course delivery begins

Each of the classrooms was entitled the Interactive Distance Learning Studio (IDLS), as a means of identifying the unique distance education environment associated with the classrooms. Table 2 shows the equipment installed in the two IDLS classrooms.

Table 2

Two cameras -- one focused on the instructor and one focused on the students
Large video monitor at the front of the classroom enabling the local students to see the remote students (see Figure 1)
Large video monitor at the front of the classroom displaying what the remote students were seeing (camera view) (see Figure 1)
Large video monitor at the rear of the classroom enabling the instructor to see the remote students (see Figure 2)
Desk-based microphones for each student
Microphone and camera tracking device worn by instructor
Twenty networked microcomputers

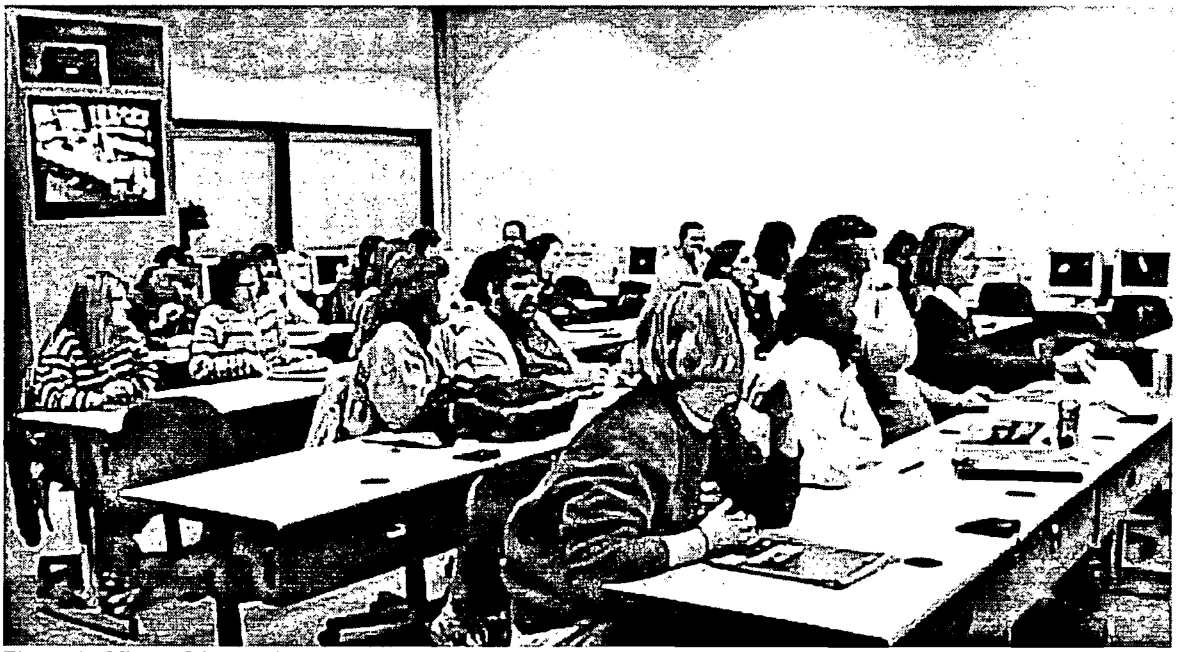

Figure 1: View of the local and remote students in the IDLS

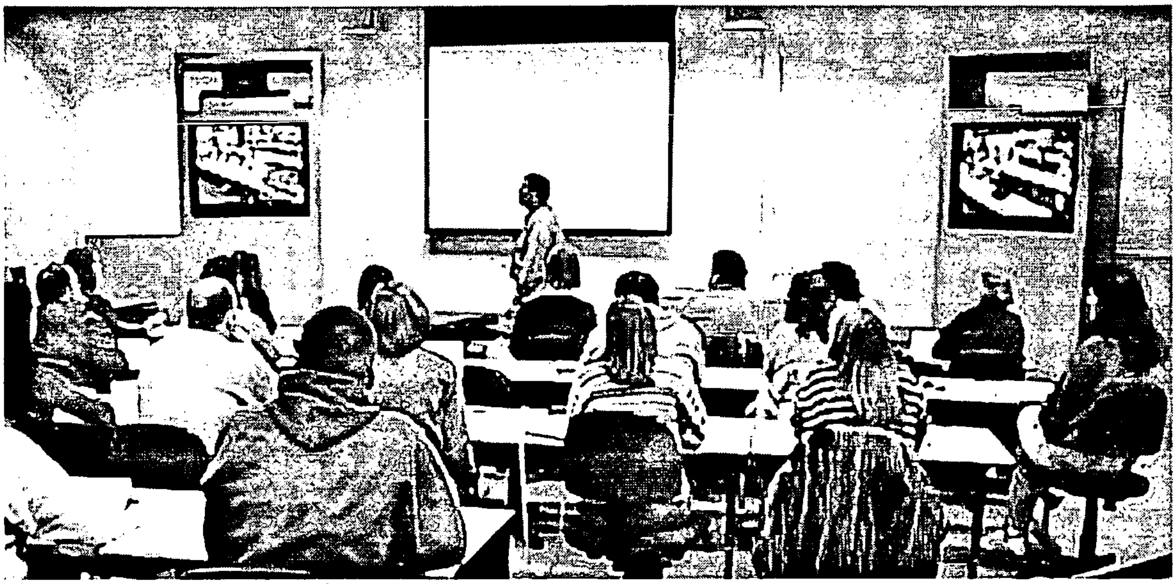
Figure 2: View from the rear of the IDLS, showing the remote students

The initial courses offered in the IDLS were taught by the Instructional Technology (IT) department faculty. This administrative decision was based on the premise that the IT faculty would be more willing and motivated to use the telecommunications technology for course delivery. Also a facilitator was provided for each interactive video course. The facilitator supervised the remote site during each class meeting and provided technical and instructional support to the course instructor.

Methods

This pilot study consisted of interviews with the instructors at the conclusion of the first semester of classes delivered via interactive video. The interviews were all conducted by the author, and we re designed to elicit primarily qualitative information about the teaching experience. The interview questions were structured as follows:

1. What technical considerations were involved in teaching in this environment?
2. What is required of students in this environment?
3. How did the facilitator contribute to the instructional environment?
4. What teaching styles or strategies did you employ in this environment? How was this different from a conventional course?
5. What insights or recommendations can you offer to instructors teaching via interactive video?

Results and Discussion

The following is a condensed summary of the instructor responses to the interview questions.

1. What technical considerations were involved in teaching in this environment?

In terms of technical considerations, instructors raised several issues. The need for practice and skill in addressing the camera (and therefore the remote site) was commonly mentioned. Addressing a camera while teaching was an unnatural activity and required behavior modification on the instructor's part. Similarly, interacting with remote students was a challenge. There was a perceived lack of immediacy in addressing and responding to the remote students on the video monitor, as opposed to the physically present local students. Also instructors needed training in operating and switching the cameras (from instructor to students) via the touchpad. Remembering to switch the views at appropriate times was also a challenge. Instructors had to manage and deal with possible technical difficulties with the wearable tracking microphone, the camera touchpad, the document camera, and a computer-based presentation.

2. What is required of students in this environment?

Interaction with the instructor and remote students were the key issues here. In this type of environment, students must always use the desk-mounted personal microphone for interaction with peers or

the instructor. Otherwise the remote site is excluded. This requirement often limited or silenced interaction, particularly short comments or witticisms. Short comments may be perceived as not worth making, weighed against having to wait for the instructor to recognize and get the camera switched to the student. Students had to adjust to being on camera and seeing themselves on the video monitors. Whenever a student wanted to make a comment, he or she had to be prepared for the camera to automatically turn and zoom in for a close-up. This video attention may have discouraged shy students from participating. Interacting with distant students was unnatural, and the technical and time requirements to involve remote students had the potential to create resentment with the local students.

3. How did the facilitator contribute to the instructional environment?

The facilitator evidently is a very important factor in determining the quality of the experience of the remote students. It is highly desirable that the facilitator has subject matter, as well as technical expertise. The facilitator supports the remote students by clarifying parts of the instruction, distributing materials, maintaining order, and encouraging interaction. Interestingly the remote students may develop a closer affiliation with the facilitator than with the course instructor, and this must be considered. The facilitator was often a comfort to students in this new and unfamiliar environment. For remote students, the facilitator is perceived as "theirs".

4. What teaching styles or strategies did you employ in this environment? How was this different from a conventional course?

Much more instructional planning was needed, including planning for any instructional materials to be available at both sites. Entire meetings needed be scripted like a stage play, including interaction within and between sites. Some instructors perceived that they "needed to be more linear" in their lecturing style, due to the video medium. A common remark was that it was much less effective to "wing it" -- that is, deliver unplanned or less formal presentations. Many instructors indicated they questioned students by name, rather than using open-ended questioning techniques. Open-ended questions went unanswered, possibly due to reluctance of students to draw camera attention to themselves. Instructors attempted inter-location discussion and collaboration via video in class and asynchronous Web discussion outside of class. Some instructors attempted to be more entertaining, and to try a variety of teaching methods to maintain the attention of the remote students. One instructor perceived that he was less mobile (moving throughout the room) due to the limited range of the tracking instructor camera.

5. What insights or recommendations can you offer to instructors teaching via interactive video? The following represents summary statements from the interviewed instructors.

- Students' disdain over seeing self on camera led to decreased participation from some students, and domination of discussion by others.
- Using student microphones destroys spontaneity. The technology suppresses jokes, clever remarks, or quick interchanges. (Is your witticism worth stopping the show?).
- There was some rivalry and potential for resentment between sites. Wherever the live instructor taught was perceived as the "main" or "favorite" group. Larger remote class size (over 10) makes interaction difficult (seeing faces, etc.)
- In unfamiliar waters it's good to appear "in command" to reduce student anxiety.
- Travel to and teach from the remote site often if possible.
- The entire class meeting must be scripted like a television show.
- Use inter-site collaboration/discussion to prevent "us vs. them" rivalries from developing.
- Less content can be covered than in a traditional class. Use the Web to continue class discussions.
- Audio and the interaction dynamics associated with it are the most important technical considerations.

- Lower-level skills may predominate (reading, memorizing) while analysis and synthesis are difficult due to discussion constraints (microphones, cameras).
- Short lectures (10 minutes) is about all the remote students will tolerate. (One instructor commented, "I'm not Tom Cruise", meaning he was not a polished video entertainer).
- The instructor must spend adequate time during the first class meeting orienting students to the environment and requiring them to use the technology. This reinforces the required interaction conventions.
- Team teaching between sites requires even more planning, and differences between instructors can cause difficulties.

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DISTANCE LEARNING AND DISABILITY ACCESS: A SUCCESS

Kay A. Persichitte
Kay A. Ferrell
Nathan Lowell
Stephanie Roberts
University of Northern Colorado

This paper describes a three year grant project (Federal Grant #H029A70113) at the University of Northern Colorado to design and deliver a graduate master's degree program in blindness and visual impairment to the 14-state region of the Western Interstate Commission on Higher Education (WICHE). The project, funded by the US Department of Education, began in January of 1998. The $1.1 M grant project currently offers courses to 78 students working to complete 17 to 62 semester hours of coursework (depending on previous training and experience). Additional funds have been contributed by private and state sources. These students are geographically distributed across 18 of the United States, over half of them in states without personnel preparation programs in blindness and visual impairment. The first classes were delivered in the fall of 1998. Fourteen courses have been converted for distance delivery as part of this project. In the fall of 2000, eight courses were delivered with a total of 86 students registered.

While students who are blind and visually impaired (BVI) represent less than one-half of one percent of the school age population, they are a group of students with multiple and often complex educational needs. One of these needs is for a specialized teacher trained in the methodologies of blindness and the adaptations necessary to facilitate access to the general education curriculum. Rural school districts do not easily meet the needs of these students, in part because of the cost of hiring these specialized teachers, and in part because qualified teachers of students with visual impairments are in short supply. The shortage grows yearly (Ingersoll, 1999), as universities close teacher preparation programs that require significant investments in fiscal and human resources without producing equivalent tuition revenues.

Less than 400 new professionals in blindness and visual impairment enter the field annually (Ferrell, 1999). The teacher shortage in blindness has become so severe that the Office of Special Education Programs funded a special project to investigate the depth of the problem and to develop a national plan for meeting the personnel needs of the future. Although the results of this project have not yet been published, it appears that the nation's capacity to prepare specialized teachers is sorely stretched. Using technology to train teachers at a distance, especially in those states that do not have teacher training programs in blindness, is one way of expanding the nation's capacity while permitting students to remain in their current jobs in their home communities. For rural school districts, this may be the only way they will ever recruit a specialized teacher for their children with visual impairments. A particular challenge of this project has been to provide a quality graduate education experience for practicing educators who cannot leave the special needs populations that they currently serve to re-tool for this area of specialization.

Project Description

At the culmination of the three-year funding, this project has increased the graduate admissions to the Master's program at the University of Northern Colorado (UNC) over five-fold. Graduates of the program each year now outnumber the previous cumulative graduation total for a four-year period. Seven faculty have participated in the re-design and delivery of their courses using eight different distance technologies and media. Students who are themselves BVI are participating and we have recently added an instructor who is blind and teaching from a remote state.

The BVI faculty at the UNC have a deeply held philosophy about this severe needs program. It was agreed early on that the distance delivered program would subscribe to the same philosophy and that has influenced many design and implementation decisions. The philosophy statement is:

"The UNC Severe Needs: Vision program is based on a firm and continuing commitment to the rights of all students with visual and other disabilities to receive equal educational opportunities, including equal access to the curriculum. The faculty believes that each learner should be provided educational opportunities that maximize potential for whatever level of independence is possible in order to be productive in society and to live a meaningful and fulfilling life."

This philosophy has become a guiding one in design and development decisions related to meeting the needs of our BVI students. The concept of providing "separate, but equal" access is completely contrary to this project. While it may be more difficult for the person without sight to take advantage of today's visual distance environments, this project demonstrates that there are many strategies that can be incorporated within distance learning environments to leverage the communication potential of these delivery technologies (see "Building Websites for the Blind: A Primer" in these Proceedings). A focus on collaboration, sharing, and contextualized experiences allows not just "teaching-by-telling, but learning-by doing" (Stanard, 1999, p. 49).

This project is one example of Molly Broad's comments about virtual learning, or the "fundamental importance of high-quality faculty and effective interaction, both between faculty and students and among students. Faculty rightly believe these are fundamental to good education; however, with the growing array of technology tools, it is possible to achieve those objectives online. In addition, virtual learning can also bring a very rich array of academic resources to the learning process--resources that address the multiple learning styles of students, and resources that greatly enrich the educational materials available to students" (Morrison, 1998, p. 3).

The project team consists of a Project Director and Project Coordinator who have served (along with other special education faculty) as subject matter experts, a faculty member from educational technology who has served as the primary instructional design and distance delivery consultant, and multiple graduate students from educational technology who have served as designers, developers, technical assistants, professional development coordinators, and as remote student support staff. Adequate investment in both human and technical resources is one reason the project has been successful. Enrollments are now stable enough to sustain the delivery of the distance program without additional grant funding.

The delivery of the degree program is grounded in a robust web environment that offers content, additional resources, and student support tools. Every course includes a website, threaded discussion, class listserv, and synchronous chat. Other customized components of courses include web-based interactive quizzes, case studies, multimedia tutorials, customized videotapes, and links to multiple special needs organizations. In addition, there is a web-based virtual university center (listserv, synchronous chat, bulletin board) for the students to use for communication and collaborative projects, and a threaded discussion area specifically for faculty involved in distance education efforts. The development of a sense of community for these learners and faculty has been the recent focus of project refinement and elaboration efforts through scaffolding communication and creating a sense of place for remote learners.

Design and Development Issues

Instructional design (ID) issues that have influenced the project cut across a broad range.

- alignment of course content with four sets of professional standards
- special education faculty review of course objectives for overlap and update
- introduction/implementation of the ID process (generically: ADDIE for analysis, design, development, implementation, evaluation) with special education faculty
- helping discipline faculty in their reconceptualization and adaptation of traditional instructional strategies
- delivery system and media selection that are compatible with the adaptive technologies used by BVI learners (e.g., screen readers, braille keyboards) and content appropriate
- materials development with attention to the special needs of the BVI, but not to the exclusion of the creation of visually stimulating materials and environments for the sighted learners and instructors
- discipline faculty preparation and support as they teach in these mediated instructional environments
- complete revision of student assessment and evaluation to a standards- and performance-based model
- creation of student and faculty support materials

Other issues that have surfaced are related to the administration and implementation of distance learning programs.

- faculty and student access to distance technologies is not yet ubiquitous; high quality, dedicated technical support is essential
- importance of strong administrative support from the College of Education Dean
- project management requirements were underestimated (timelines, coordination, collaboration)
- the degree program is complex due to state licensure requirements and this complexity is compounded when students participate from multiple states
- the participation of non-special education faculty requires additional time and design support
- other campus support systems (e.g., Academic Technology Services, Registrar, Scheduling) must be administrative partners in such large scale efforts
- facility design was required (WWW access stations; digital video development station; compressed video classroom, access to adaptive hardware and software)
- technical considerations at the development level and the end user level (e.g., website compatibility with screen readers, software versions, Web browsers and their configuration; software downloads) must be addressed simultaneously
- remote student access to registration, library resources, textbooks, advising, financial aid, and other support services in a university environment unprepared for these requests.

Delivery Systems and Media

The project purposefully employs a wide variety of distance delivery systems and media. In particular instances, materials are developed in more than one media to allow all students (sighted and non-sighted) access. Though not a stated objective of the project, an unintended consequence has been that the students are increasing their use of and comfort with technology, in general. All members of the project team believe in the power of technology to meet learner needs and in the importance of better preparing teachers to effectively utilize technology with their students. For these students who will teach children who are BVI, Hardman's (1999) comment strikes a loud chord, "A technologically competent work force in the education industry is needed to continue to keep the promise of universal education: to leave behind no child who is willing to try" (p. 4). The project relies on the WWW, compressed video (CV), text (student handbooks and coursepacks), videotape (custom and commercial), CD-ROM (custom), a required campus component during one summer, computer video conferencing, synchronous and asynchronous communication via the Web, audioconferencing, and commercial satellite downlinks.

The discipline faculty felt strongly that the distance delivered program should be as student-centered as the campus program. The design and development process has consistently incorporated Sorg and Truman's (1997) recommendations for creating quality student-centered virtual classes. Their recommendations included personalizing instruction, humanizing the course pages, providing advance organizers, and assuring easy navigation between and among course topics. During the grant period, the project website has undergone three substantial re-designs. Each one has brought us closer to the desired student-centered, interactive, facilitated distance learning environment that is our vision.

Though multiple media and distance systems are used to deliver this program, the WWW is the central learner and instructional resource for the redesign of each course (http://vision.unco.edu/). A standardized navigation shell was custom created so students do not feel "lost" each time they begin a new course in their program. Each course, however, relies to varying degree on the Web for the delivery of instruction. All courses have embedded syllabi, links to the four sets of discipline standards and course standards, course requirements, description of course activities, an asynchronous threaded discussion area, a synchronous discussion area, course schedule, and a place for additional resources that may or may not be web-based. Each course also has a dedicated class listserv. Some of the course websites include interactive custom-designed tutorials, samples of student projects, links to external assistive software, and multimedia authored graphics. The project website is not password protected, but all course sites are. The variety of technologies in use has increased as the discipline faculty has become more comfortable with trying new instructional strategies with remote students.

Remote students have access to several support systems that have proven invaluable to the satisfaction and success of the learners.

- online Graduate School admissions application
- student handbook for project participants (available in text and as a PDF file on the Web)
- toll-free phone into the Special Education Division office
- a Webmaster who responds to individual technical problems with near 24/7 response
- CD-ROM with web browser and style sheet options to load on home computers
- course enrollment and program enrollment listservs (subscribers include students, faculty, and the grant team)

Lessons Learned

- Facility design of distance education learning environments (DELEs) is expensive, time consuming, and requires substantial technical, pedagogical, and academic expertise related to distance delivery of instruction.
- ID and FD (facility design) need to evolve simultaneously for DELEs that utilize multiple delivery systems/media.
- Substantial advance planning and continual project management is critical to initiatives of this scope.
- Most of the distance delivery technologies today are visual technologies; consequently there is significant attention required to specialized design and development considerations for this project and for any other distance effort that strives for equal access for disabled learners.
- Faculty introduction to and training for using these technologies for instructional purposes is particularly important to project success, learner satisfaction, and continued faculty involvement.
- Meeting individual learner needs, faculty expectations, and content requirements are not mutually exclusive in the creation of a DELE, but the process is extremely complex.

Future Directions

Federal funding ends on December 31, 2000 and the staff have applied for additional funding to continue the project and keep up with changing technology. Our next steps include technical assistance regarding online course delivery to other universities with programs in visual impairment and blindness, as well as licensing of the courses for delivery at other universities. Discussions are also proceeding related to using this design and development effort as a model for other low incidence disability degree programs.

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BVI Resources

Bobby	http://www.cast.org/bobby/
EASI at Rochester Institute of Technology	http://www.rit.edu/~easi

"House of Style" CSS Tutorials	http://www.westciv.com/style_master/house/tutorials/index.html
IBM Accessibility Center	http://www-3.ibm.com/able/
Microsoft	http://www.microsoft.com/enable/
TRACE at University of Wisconsin-Madison	http://trace.wisc.edu/
World Wide Web Consortium's Web Accessibility Initiative (WAI)	http://www.w3c.org/WAI/
WWW Consortium's Synchronized Multimedia	http://www.w3.org/AudioVideo/
W3C Validation Section	http://www.w3.org/MarkUp/#validation

FACILITATING HIGHER ORDER THINKING: NEW TEACHER'S DILEMMA

Vicki S. Williams
Barry O. Williams
Penn State Harrisburg

Introduction

International interest in the use of the Internet and the World Wide Web (WWW) in learning environments has become the major area of focus for many educators and instructional designers. While few dispute the value of hypermedia in instruction and training, the design, development, and implementation of web-based learning has not been researched in any exhaustive way. This paper will examine the experiences of one design and development team attempting to encourage critical thinking skills among a group of pre-service teacher education students.

One of the basic components of the course, Higher Order Thinking for Educators, a course required of all students majoring in Elementary Education, is a series of case studies. The cases introduce the students to problems faced by teachers in public schools today. The course currently employs five case studies to allow the students to examine a situation, discuss its components, and arrive at possible solutions to the scenario, based on small group discussions. The learning objective for the cases was to enable pre-service teaching students to enhance individual problem solving abilities. These students were dispersed in various locations within the state in clinical experiences and spent only limited time in class with the cases. It was hoped that the students would improve their higher-order thinking skills and problem-solving abilities if they spent more time working with the cases outside of class and then be able to transfer what they had learned to new situations in their school environments.

Why Case Studies

Case studies have been used effectively to provide scenarios containing problems that exist in real life situations. Since successful decision-making is based on experience, and many students lack experience, case studies serve to simulate experiences and enable better decision-making for novices. Kowalski, Weaver, and Henson (1990) refer to case studies as "...descriptions of a decision or a problem...normally written from the perspective of the decision maker involved. ...Once they have been developed, cases are used by students as a way of putting themselves in the decision maker's or problem solver's shoes." (p. ix). According to Wasserman (1993), using cases in teaching encourages learning by insisting that learners and teachers deal with first-hand knowledge and allow students to think critically about the situation, making sense of all the parts of the case. Then, they can make a truly informed decision.

Why WBT?

Considering the geographic dispersion of the students, the any time, any place nature of the web offered expanded access to the case study. It also provided an opportunity for students to self-pace their learning and think in greater depth about the situation described in the case. Students also had more time to reflect on the information they encountered and uncovered. To encourage this increased student-content interaction, the designers used digital photos of the individual players and made the scenario as believable as possible turning the case study into a simulation. Using images and text together, the team attempted to create a case whose "lessons learned" would transfer to real life. It was important that the students could identify with and put themselves in the "shoes" of the new teacher portrayed in the case.

The Design Team

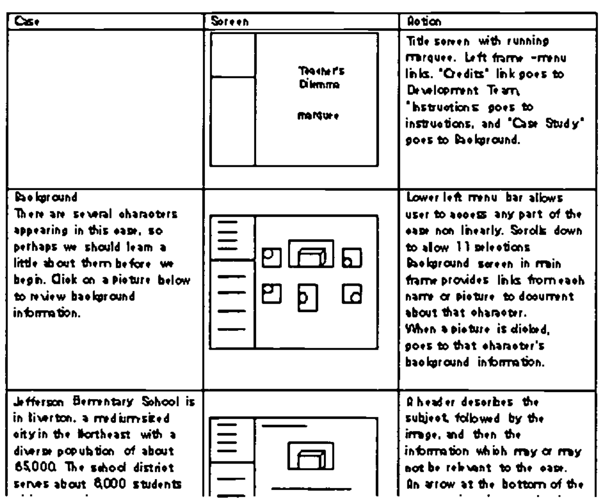
One case was selected for conversion to web-based delivery and was designed and developed by a cross-discipline team consisting of two students and four faculty members. In total the expertise of instructional designers, a content specialist, and technology experts were integrated to design and develop this unique web-based learning experience. The two instructional designers had experience conceptualizing and designing computer-based instruction and WWW applications. Additionally, each had expertise applying pedagogical theory to instructional objectives. The course instructor, who had extensive experience in problem-based learning, provided content. On the technology side of the team, both student programmers and the advising Information Systems faculty member were experienced in developing programs, especially utilizing WWW-based languages.

Initially, the team reviewed the case to make certain that all participants understood its content and the objectives for the activity and discussed ideas related to screen design and navigation. For instance, it was agreed that the online version must be creative, engaging, interactive, and utilize motion and sound where appropriate. One particularly critical activity in this initial stage was facilitating the content specialist's realization of the potential of the technology. While she had experience with case-based problem solving, she had little experience with the WWW and associated technologies. No attempt was made to determine exactly how concepts would be presented, since in this particular situation, the subject matter expert (SME) was also the client. Thus, it was imperative that we educate the client about the capabilities of web-based training before discussing issues such as video clips or animated gifs. Specifically, it was critical that she understand the nonlinear nature of the WWW and its interactive capabilities.

Design and Develop

The storyboard (see Figure 1) was a funnel for our brainstorming sessions. Capturing the essence of these sessions, we developed a board. In addition, we adapted a typical storyboarding situation to capture the transformation of the written case to a proposed screen design and related actions. The left side of the storyboard frame is a textual excerpt from the actual case. The center column of the board represents the proposed screen design, encompassing both graphics and text. On the final and right board are actions to be integrated into the design.

Figure 1. Storyboard



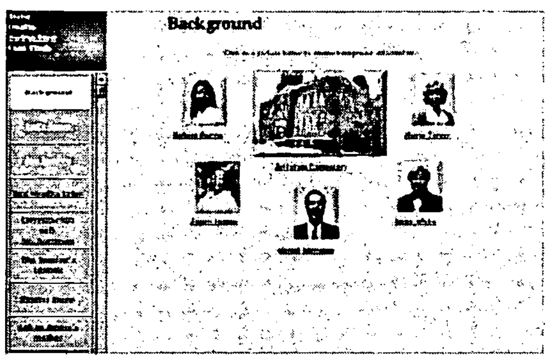
Storyboarding and graphic representations of instructional screens and site maps flowed out of brainstorming sessions and into the prototype product. Using various tools for this project such as Asymetrix© ToolBook, Hypertext Markup Language (HTML), JAVAScript™, and JAVA™ applets, the

Rapid Prototyping phase of the process involved an actual working model of a portion(s) of the storyboard. The team reviewed the prototypes biweekly, and these review and revise sessions resulted in the client / SME's having a better vision of where the website was headed and could make recommendations for smaller changes. We discussed the need for forthright feedback and were particularly concerned that our student developers would be offended by faculty critiques. However, this concern was unfounded and the students soon felt comfortable debating issues during these sessions. The subgroup of student programmers with the faculty advisor worked to produce the prototype for each subsequent review session. As the website developed, animation, sound, and interactive segments were integrated into it, bringing the product through a startling evolution in the period of a year.

The Product

The final product was a website consisting of approximately 25 webpages that utilized the strengths of the WWW, such as hypertext links to resources and learner-directed menu choices. They consisted of a home page (see Figure 2), acknowledgements, instructions, and the case study. The case itself was divided into sections, organizing the story into its critical chronological stages. In the first section, students are introduced to the new teacher, the student, the principal and other teachers in the school. Demographics were available on the school itself, but the learner determined the order of information access and, in fact, whether or not to access the information at all. While making the information available, it was up to the learner to decide what information they needed and to discriminate between useful and nonuseful information.

Figure 2. Getting Acquainted



Links to resources such as student records and school guidelines were also embedded in the story and the learner had to decide to access the information. There were no menu links to these resources, as a practicing teacher would have to decide with in a real situation what information they might need to facilitate their decision-making. The client/SME specifically wanted students to have to actively investigate the resources, not just have them handed to them in the menu.

Student remote access was taken into consideration and any motion objects were animated gifs rather than video clips to eliminate download waits. Sound clip file sizes were kept small for the same reason and were only used where they supported the content or were used as an object of interest.

Results of the Pilot

A field test of the product was conducted in the content specialist's spring semester of the course. At the end of the course, Likert Scale attitudinal surveys were completed by the 49 students. The feedback from these surveys impacted the final product, which was implemented the following academic year. The results (see Table 1) showed the students were very positive about the instructional value and aid to retention that the WWW based case study afforded them. They liked having control over the navigation

through the site and the accessibility of the instruction. Through the WWW they could spend as much time as needed in thinking through the scenario and their recommended solutions to the "Teacher's Dilemma" case. In addition, the client/SME was delighted with the resulting product and was encouraged to think about other applications of technology within the existing curricula.

Table 1: Student Rankings of Key Variables

	Student Average Ranking
Content of Study:	
Memorable	4.24
Realistic	4.47
Thought Provoking	4.41
Computer as a Medium	
Pictures Added Meaning	4.59
User Friendly Instructions	4.12
Ease of Navigation	4.22
Comparing Paper to Computer	
Interesting	4.22
Enjoyable	4.37
Informative	4.63

The scalability of this project indicates the process can be successfully replicated in the remaining case studies of the course, if desired, as well as be applied to similar projects in other disciplines such as training and development. Providing controlled but accurate experiences, while still allowing for safe cognitive exploration, would encourage trainees to examine the various aspects of the situational simulation. The cost-effective nature of the web-based delivery makes this an attractive alternative to paper and ink.

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WHAT SOFTWARE SPIDERS CAN TEACH US ABOUT COLLABORATION

Ruth Gannon Cook
Joseph Giarratano
University of Houston Clear Lake
Ken Jenks
Independent Consultant

Crossing over academic disciplines in higher education is seldom done unless there is a compelling reason, such as the information technology department overlapping into the social science department in an online history course. Ironically, different departments can often be located in the same building, yet the walk across the hall from one college to another can be a very long one. Two departments working together on a project, particularly in departments like the College of Technology or the College of Education, can prove more difficult than the biblical expression "passing a camel through the eye of a needle."

Occasionally, however, in social greetings, conversations can ensue that have a synergistic effect and grow into joint projects. Collaborative efforts develop between colleges that have not previously worked together. Such is the case in this study. Two instructors from different colleges in a university casually discussed a research project that could benefit both departments. They would create a project that would combine student and technology resources in both departments. Once the idea was conceived, the two instructors decided upon a topic, a research methodology (qualitative), then embarked upon the task of assigning the project to students in the fall semester of 1999. The basic concept was to develop a software "spider" that would search the World Wide Web to detect student plagiarism using keyword and textual searches. Such spiders and other software tools, like intelligent agents and knowbots, are commonly used to reduce the time of mundane repetitive Internet tasks. (A good example of such a task would be finding the lowest airfares online, or looking for sites with the lowest mortgage rates, etc).

Since the first instructor worked in the Instructional Technology (IT) Department in the College of Education, she was familiar with both curriculum design and software applications, but even though she taught technology applications and courseware design, none of her students had actually created any software. There had never been an opportunity to design or test a product in her classes, so she wondered how that process could be experienced with students. Moreover, her research had been concentrated on the effects of semiotics on courseware design (GannonCook, 1999; GannonCook 1998). She felt it would be interesting to actually design a software program with a metaphoric theme and see if this theme facilitated recognition for the functions and features of that course. She had been searching for a way to create both the software and a way to test the importance of metaphor in software design.

The second instructor worked in the Computer Science (CS) Department. He had written numerous textbooks on computer instruction and supervised graduate students' software designs for many years. One of the more interesting courses that he taught actually mentored students from the first stages of design all the way through to the dissemination of the product. This course was called a capstone course because it was the culmination of the students' learning and the alternative to a Masters' thesis. The capstone course usually included outside mentors that worked with students so the students would get a real world understanding of development teams. Students in his courses have worked with mentors from NASA, industry and business, and other universities to develop actual products instead of just going through classroom programming simulations. His software projects have covered a wide array of products and have also incorporated website design, database creation as well as various types of hypermedia into this capstone experience.

During one of their friendly "water cooler" discussions, the second instructor mentioned he had students who could work in internships and that there might be a student who would fit the needs of the IT instructor 's dream project. After several additional discussions, they decided that, indeed, this project might be one that could be meaningful, not only for this study, but others. If research could be conducted on how the software was developed, how the software metaphors were selected, and how the software

application functioned as an Internet spider, it could provide meaningful data to both colleges within the University (Gallini, Seaman and Terry, 1995; Verene, 1993). So they went back to their worlds and worked on a research plan, then reconvened to collaborate and combine their plans (Bertalanffy, 1968; Bonk and Cunningham, 1998; Bonk and King, 1998).

A pleasant surprise to both instructors was that their plans and objectives turned out to be very similar (Ferris, Roberts, and Skolnikoff, 1997). They discovered that, despite different departments, their philosophies and design strategies were compatible (Dillon, 1996; Dillon and Gabbard, 1998). They converged their research objectives into one plan, which they set out to implement through the collaborative capstone project with one or several graduate students (Goss, 1996; Hirumi, 1999; Kauffman, 1978).

A timeline was created and a search for students ensued. Once the team of students was selected, a third person who had volunteered to mentor students in the software design was invited to join the team. Several students were selected to participate in the project. Now the team members would see how the ideas could be developed into a product. Hopefully, they would also observe how the student or students created the software program and how the student(s) learned to work with others in a collaborative team environment with other group members. It would be crucial that members work well together and communicate status of each phase because of the short amount of time allocated to create and complete the project (Havernik, Messerschmitt and Vandrick, 1997).

Several students opted out of the project for various reasons, so it distilled to one student who was a very proficient programmer, but was not from the United States so English was not his primary language. He had no experience working in the United States either, so it would be a new experience to work with other nationalities in any kind of collaborative environment. This student was assigned to work with the IT teacher and was told to embark upon his course with "an open mind and a handy notebook".

Once introduced to the IT instructor, they had a lengthy discussion about the instructional design of the project and how that design would dictate both the software design and implementation. The original idea had been to design a software program that would search out plagiarism on the World Wide Web. The collaboration between the student and the IT teacher would be an experiment too, since both were coming from different disciplines and backgrounds. Fortunately the student and IT teacher worked well together, and the experiment resulted in the student's design of a spider software program that would search out plagiarism on the World Wide Web in a number of search modes.

The second instructor then reconvened with the first to discuss and review how the collaboration between the IT teacher and student had worked, and to assess the success of the software design. The overall success of the interdisciplinary collaboration would be gauged by the functionality of the software. But the ongoing success of the project and future collaborative projects would depend on the ability of the team members to work well together.

The student worked with the IT instructor, the programming mentor, and the CS instructor and developed a software program that would search out and find plagiarism on the Internet. He created Java servlets for the web server; search forms and software to act as spiders that would catch plagiarized online works, and built search engines that would search for classes of searches by author, phrase, and direct hits. Altavista was selected as the commercial search engine of choice to utilize the spider program for searches, and the spider software was designed to send e-mail to both the plagiarism transgressor and the creator of the plagiarism search. An administrative program was written that created and administered a database of information extracted from the web searches. Last a program was written (a phrase highlighter program, or PHP), that allowed any user to submit to submit documents using HTML forms and review uploaded HTML forms.

In this instance the team members worked well together, meeting periodically and sending each other e-mails to report the progress or challenges of the project. The results were the creation of the program that provided information on where plagiarism transgressions existed and advised searchers of these infringements. The project went well and the team members discovered that some of the most frustrating problems occurred, ironically, not because of design or collaborative efforts. Most of the problems revolved around server hardware and software problems. Since students only had one semester to create their projects, the student involved in the spider project could only create the basic program and had to leave improvements to be made in future capstone projects.

Lessons Learned from Working with Spiders

The creation of the spider project provided a product, but even more important, it created a collaborative web for all of the participants. It interwove threads between the two departments that had not really worked together prior to the project; it involved the student in a real-world scenario with deadlines and diverse corporate partners; and it created an actual product that could prove useful in the Internet marketplace. The IT instructor had the opportunity to participate in the actual creation of a product. In addition she was able to assist in creating a product that used a metaphor, the spider web, which could also be assessed for relevance and user recognition (Lee, 1985). Future research could look at metaphoric content and research the effects of these factors on the ease of use of these kinds of products.

The CS instructor had the opportunity to observe how his capstone student worked in a collaborative group environment with both corporate mentors and another department within the university. He felt that this was a particularly beneficial experience for the student because the university mentor was an instructional technologist. She had provided the student with valuable insights on how to prepare his documentation for review by other team members and had given constructive feedback on the functional design of the product. The CS instructor felt that future collaborations could provide even more insight into team project development and hoped additional projects would emanate from this effort.

The third mentor, the entrepreneur, was excited about the project because, as a corporate e-commerce entrepreneur, he had acquired a potential employee to develop future commercial products with the help of interns that needed the real-world experience of working for a corporation. There would be opportunities to develop grants to provide to the university by corporate sponsors for the continued creation of projects like the one developed in this study. It was a good incentive for the mentor to consider additional collaborative efforts with the university on future projects.

The capstone project was beneficial to the student because it not only gave the student deadlines and scenarios similar to the ones he would encounter when he graduated, but it also gave him the experience of working collaboratively in a team. He created the product required for the satisfaction of the capstone course requirement and graduation, but walked away with a better understanding of what it was going to take to actually communicate his ideas and programs. The student provided his observations to his instructor in a journal. Here are some excerpts of his final thoughts on the spider project experience:

- Team spirit is very important for the success of the project.
- Whether the project succeeds or not is mostly decided by the client's satisfaction with the product.
- The skills necessary to create the product are crucial, but so are the presentation and communication skills necessary to convey what needs to be done to make the product possible (Zhong Xie, 1999).

He had emerged from the project with a respect for qualities he never before had considered to be important in writing programs and creating software, the qualities of good communication and reliability.

The outcome surpassed the two instructor's expectations. The project created by the collaboration had cast a web that reached far beyond the original idea formed at the water fountain between the two departments. It had become more like the old children's nursery rhyme of the "Itsy Bitsy" Spider. The rhyme describes the "Itsy bitsy spider crawls up the water spout, down comes the rain and knocks the spider out. Out comes the sun and dries the spout again, so the itsy bitsy spider goes up the spout again." (Anonymous nursery rhyme)

There had, indeed, been times when the project had been knocked down, then the team and student "climbed up the spout again" by trying another option or persisting until a solution was found. The result was the creation of a software program that could be resilient and survive downpours of everyday virtual functionality.

The spider proved to be a good metaphor, demonstrating resilience and casting its' web to catch intruders. This software spider taught a memorable lesson about respect for ownership, but more important, it taught lessons about persistence. Most of all, the biggest lesson may have been learned by the interaction and participation of team members on this project. Real spiders may weave solitary webs and catch prey, but this virtual spider wove a web that was strong because of its successful team collaboration.

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Development of Program on Educational Technology in China

Meifeng Liu
Beijing Normal University

In comparison with that in other countries, Program on Educational Technology in China has its own characteristics as well as similarities to other countries. This paper will in detail introduce evolution of this Program in China as well as its current status, including job orientation of graduates and an organization related to it. Problems existing in this Program will be qualitatively analyzed. At the end of this paper, some ideas about the Program both at Beijing Normal University in China and Indiana University in U.S.A. will be addressed.

1. Social needs related to the profession of Educational Technology in China

A program exists because there must be some social need for it. It is the same as Program on Educational Technology.

In China, there is a large system of educational technology organizations. It includes educational technology in K-12 education, named Educational Technology Unit, in collegiate education, by the name of Educational Technology Center, as well as in society, such as Educational Technology Center or Ministry in bank system, in medical or other systems. In the meantime, many Educational Technology Centers exist in central, provincial, city as well as county levels. Most of them are in charge of development of educational technology in K-12 Education. Also, there are programs in universities at bachelor, master and doctoral degree levels. Therefore, professional personnel on educational technology are urgently needed in order to make the enterprise of Educational Technology run productively. It is widely recognized that Program on Educational Technology, which the professional personnel come from, is vital to advancement of the whole field in China.

2. Process of development of Program on Educational Technology in China

Simply speaking, there are two stages in the process of development of this Program.

(1) Spontaneous stage

Educational Technology was born in 1920s in China. In 1930s, it was developed preliminarily. Program on Educational Technology in China originated from training in the 1930s. At that time, audio-visual media were applied into schools and universities. There was need for professional personnel who could operate the electronic media. Therefore, related seminars were organized by Ministry of Education as well as courses offered by some universities, for example, Da Xia University. In September 1936, Specialty of Film and Broadcast Education was established in School of Education in Jiang Su Province. In 1946, it was renamed Specialty of Electrified Education. Also, in 1938, Specialty of Film and Broadcast Education started in School of Science at Jin Ling University. These are the first try of establishing Program on Educational Technology in China.

But no further advancement happened in the later forty years because of the anti-Japanese war, civil war, cultural revolution and so on. At the end of the 1970s, Program on Educational Technology restarted at Hangzhou University, Zhejiang Normal University and Fujian Normal College in Department of Physics. At that time, it was called Program on Electrified Education because it focused only on the application and maintenance of electronic devices. Before the 1980s, the development of Program on Educational Technology was spontaneous, that means there was no central governmental layout for this Program.

(2) Unifying layout stage by Ministry of Education

In 1979, approved by Ministry of Education, two separate Institutes of Modern Educational Technology were built in Beijing Normal University and Hua Dong Normal University. They did a very good job to start the exploration of Educational Technology in China.

In November of 1983, a national conference was held on educational technology, posing a whole arrangement for the establishment of Program on Educational Technology. From then, Program on Educational Technology was gradually established in central and provincial Teachers' Universities at the bachelor level. This is the first time for Educational Ministry to assign all the issues related to Program

building. In December 1986, the Committee of Degree in State Department approved that Beijing Normal University, Hua Nan Normal University and He Bei University could award Master degrees on this Program. Further, in 1994, Beijing Normal University got the permission of offering doctoral degrees from the Committee of Degree in State Department.

Up to now, there are more than 30 universities having this Program offering bachelor degrees, about 15 universities can offer master degrees. There are three universities, which can award doctor degrees. Also, the name of this Program has gradually changed to Program on Educational Technology instead of on Electrified Education. It signified the focus of this field shift from hardware to software as well as gradually to system approach.

An academic association was formed in China in 1991 in order to deal with Program issues---Instructional Material Consult Council of Program on Educational Technology. At that year, it held a meeting. During that meeting, a unified curriculum and syllabus for undergraduate, which was developed by Beijing Normal University, passed the examination. Since then, we have had a unified standard for undergraduates in this Program.

This Council also organized and compiled many textbooks for undergraduates. Upon completion of these tasks, the name of it was changed from Instructional Material Consult Council of Program on Educational Technology to Instructional Consult Council of Program on Educational Technology, and it is responsible for research issues related to this Program. It has been helping to pave the way for the smooth development of this Program.

About the undergraduate level, in 1997, we conducted a survey about the Program on Educational Technology in Universities. There were 29 questionnaires sent out, and 17 questionnaires came back. Here are some results about this survey:

•Job orientation after graduation from Bachelor degrees

From the highest percentage to the lowest, the graduates with bachelor degrees took the jobs in :

A: K-12 education **B:** collegiate education

C: Educational Technology Centers in different levels,

D: Academies **E:** others **F:** TV Stations

G: Educational TV Stations **H:** Government departments

I: Corporate training **J:** Radio and TV Universities in different levels

K: Audio-Visual publishing press

Among those, "others" means the jobs are not closely related to the Program on Educational Technology, like business etc..

Figure 1. Job orientation after graduation from bachelor degrees[6]

[6] The data came from a survey analyzed in 1997.

• Types of work the graduates engaged in

The graduates would engage in these kinds of jobs according to the relative percentages:

A: Instruction **B:** TV program producing **C:** TV technique

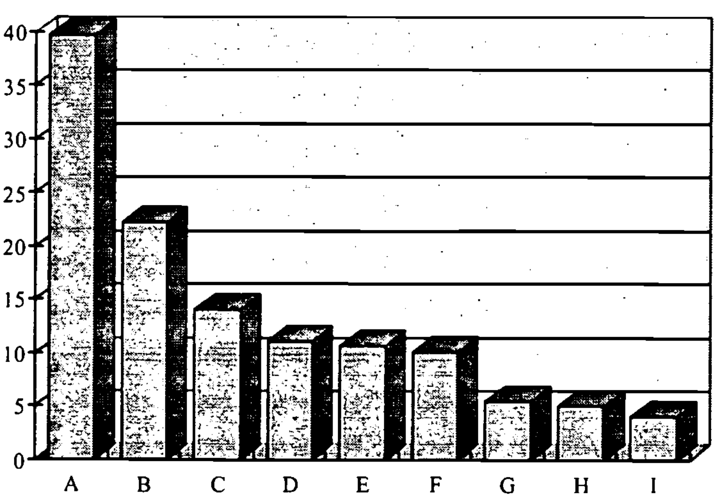
D: Producing Audio-Visual instructional materials **E:** Others

F: Audio-Visual management **G:** Software development

H: Research on Educational Technology **I:** Gathering and editing news.

The same thing as the former figure, "others" means their work is not related to the Program on Educational Technology.

Figure 2. Types of work the graduates engaged in[7]



[7] The same as footnote 1.

From these two figures, it is known that most graduates from bachelor degrees engaged themselves in the work related to educational settings. Also most of the jobs are related to the Program on Educational Technology. But there is still a certain amount of percentage of "others" not related to this Program.

3. Existing problems in the Program and Corresponding strategies

(1) There is a problem with the system as well as position of the Program.

Most universities put this Program into the Department of Physics at the very beginning. And they gradually became independent departments, but still not closely associated with Educational Departments. Also, among other Programs in the field of education, few have recognized this Program's importance.

(2) There is a problem with professional quality of faculty in this Program

Since we have had graduates with master degrees from this Program in 1990, with doctoral degrees in 1997, most faculty members in this Program come from other majors, for example, physics major. Also, most of them have not doctoral degrees, even master degrees. The quality of faculty is still a problem existing in this Program development.

There is a high need for graduates with master or doctor rather than bachelor degrees. We should have more master and doctor students registering in the Program on Educational Technology rather than bachelor students.

(3) There is a problem with the strategy of curriculum

Technology and applying technology into instruction is an important part of Educational Technology. Also, it is an ever-changing part as we forge into the information society. That leads to even more unstable content in Program on Educational Technology than that on Physics and some other majors. From a curriculum angle, we should create a balance between ever-changing social needs and stability of the curriculum system. We need to design a new curriculum strategy.

Colloquium or other workshops should formally be introduced into the curriculum system in order to make sure that students can have the latest information in this field.

(4) There is a problem with students' real-life experience either in educational settings or in corporate settings

Students in this program lack real-world experience both in teaching and in corporate training settings. Most undergraduates come to universities directly from graduation from high school. So it is difficult for them to understand some of the courses closely related to teaching experience.

A bridge should be built between the Program and the practical educational technology field in Educational as well as corporate settings in order to offer more opportunities for students to intern.

4. Case study: Comparison between this Program at Beijing Normal University and that at Indiana University

Beijing Normal University is very famous for education all over the country. Program on Educational Technology at Beijing Normal University is also a representative for this Program in China. Here are some ideas about the comparison of this Program between Beijing Normal University and Indiana University.

(1) About the system

From 1985, Program on Educational Technology had been one of three Programs in the Department of Radio and Electronics. Since 1999, it became an independent department, and together with three other departments, Computer Department, Radio and Electronics Department and Library Science Department, there established a college named Information Science College.

Whereas, Instructional Systems Technology Department belongs to School of Education.

(2) About the degrees offered

Beijing Normal University can offer bachelor degrees, master degrees and doctoral degrees on this Program. It takes students four years to get bachelor degrees, three years for master degrees, and three years for doctoral degrees. But if a doctoral student is only a part-time student, He or she can spend at most five years to finish his or her study. Not only do master students have to finish certain credits' courses, but also they should have to write a dissertation with the same process as doctoral students', but maybe not as involved as doctoral students'.

IST at Indiana University can award master and doctoral degrees. Master degree is for one to two years, and doctoral degree for three to seven years. There is no need for master students to write a dissertation, but they have to compile a portfolio.

(3) About the instruction

Most of instruction is project-oriented in IST at Indiana University. They put more emphasis on producing knowledge by students themselves. Also, through project approach, team building and cooperative ability are developed.

As to instruction of this Program at Beijing Normal University, as well as some other universities around China, we usually emphasize imparting knowledge to students. We encourage dialogues between students as well as between teachers and students, but not exactly the same way as here.

(4) About the focus of Program

Educational Technology Department at BNU mostly prepares students for educational settings. However, IST Department at Indiana University focuses on both educational settings and corporate settings.

In China, we have fewer educational software companies. Also, the training issues in companies are not very formally conducted except for foreign or joint-ventured corporations. So, there are potentials for China to develop this Program in Corporate settings in the future.

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Magazines: Educational Technology in China, Research on Educational Technology, Educational technology in foreign language teaching, ect..

About IST history in Indiana University, see Website: http://education.indiana.edu/isthome.html/students/history/history.html

CURRENT STATUS OF LEARNER SUPPORT IN DISTANCE EDUCATION: EMERGING ISSUES AND FUTURE RESEARCH AGENDA

Ji-Yeon Lee
Indiana University

Abstract

The importance of learner support has been emphasized over and over in the distance education literature but there is a lack of comprehensive analysis of this issue. Besides that, most of existing studies on learner support are based on large-scale correspondence program and few of them provide guidelines for planning and implementing support services in web-based environments for dual-mode institutions, which is the majority of distance education program providers in nowadays. In this paper, a body of literature on learner support, including various journal articles and technical reports, was examined, and three issues emerged from the review: (1) the lack of research on cost-effectiveness of learner support, (2) the lack of empirical research, and (3) the need for learner-centered approach in designing and implementing learner support. These issues are discussed in detail to enhance our understanding of learner support in post-secondary level distance education program, and it is further argued that future research should focus more on developing and refining methods for cost-benefit analysis of learner support, developing a general framework of learner support model in dual-mode institutions, and developing systematic methods to identify, analyze, synthesize, and assess the needs of distance learners.

Introduction

The needs for learner support in distance education comes from the recognition that learning in distance is often mediated by networked computers with individualistic interfaces that require learners to work alone for the majority of learning process. Since neither the instructor nor their peers are physically present to help and direct access to learning resources and facilities are somewhat limited, distance learners have unique needs, and many researchers and practitioners believe that providing distance learners appropriate support services would increase the quality of learning (Feasley, 1983; Gunawardena, 1988; Sahoo, 1993; Watkins & Wright, 1991). It is not surprising that learner support is used as an important accrediting criterion used by most accrediting agencies (The Institute for Higher Education Policy, 2000; Broad, 1999; Mantyla & Gividen, 2000).

As more and more post-secondary institutions are offering distance education programs or planning to do so in the near future[8], there is a great need for research on designing and implementing learner support services. However, the majority of existing studies on learner support are based on large-scale correspondence programs (i.e. Open University in U.K.), and few of them provide a comprehensive analysis of support services in web-based environments or guidelines for establishing and managing learner support systems in dual-mode institutions (Koble & Bunker, 1997; Simonson, Schlosser, & Hanson, 1999).

There can be several forces underlying the gap between research and practice of learner support, but Robinson (1995) attribute the following two reasons to explain the situation: (1) learner support has been perceived as peripheral to the 'real business' of distance education which is developing course materials, and (2) many researchers tend not to consider learner support as a suitable topic for research since it is contingent on local circumstances and thus not easy to generalize the findings.

[8] According to a 1999 survey by the National Center for Educational Statistics (NCES), nearly 1/3 of all 2-year and 4-year postsecondary institutions offered distance courses in 1997-98, and additional twenty percent of them were planning to offer distance courses within three years.

His points may have been relevant in the past when distance education was viewed as inferior alternative to traditional face-to-face education and the emphasis was on the product, rather than the process. But things are changing, if not already changed, and distance education is considered as a major phenomenon in higher education these days. Distance learners are much more sophisticated, diversified, and demanding than ever, and they expect a lot more than well-designed learning material. Besides that, the competition among distance education providers is such that if an institution fails to satisfy the students, it will loose them to one of its competitors. Thus many institutions offering distance education programs are struggling to better meet the needs of their students. Unfortunately, research on learner support at this point is not able to provide much guidance for the institutions to cope with these problems, and practitioners are learning the lessons in a hard way – by trials and errors.

After reviewing the literature, three issues emerged as most problematic areas in research on learner support: (1) the cost-effectiveness of learner support, (2) the lack of empirical research and the difficulties in generalizing research findings as a result, and (3) the need for learner-centered approach. I believe tackling these issues with greater depth will help enhancing our understanding of learner support in distance education and also help advancing research in this area. Thus the purpose of this paper is to review current status of research on these three issues and suggest recommendations for future research on learner support in distance education.

Definition of Learner Support

Defining the key elements and boundaries of learner support is important in research since it provides a criterion in determining the standard or quality of learner support. However, learner support is rather a broad concept and its definition varies (Robinson, 1995; Sewart, 1993). Some researchers consider resources and interactivity as critical in defining learner support (Garrison, 1987) while others put more emphasis on individualization or customization of services (Thorpe, 1988; Tait, 1995).

There are two distinctive views to approach learner support – supplementary and complementary/holistic (Robinson, 1995; Tait, 1995; Rowntree, 1992; Nunan, 1993). The former is more limited in that learner support is confined as an add-on to course materials or other learning experiences while the latter view it as a crucial factor which pervades the entire education program and something without which distance students' learning experience cannot be complete.

It seems that more and more researchers are taking a holistic approach considering learner support as an integrated part of course and the entire learning process (Sache & Mark, 2000; Scalzo, Matela-Rodier, & Ferrauilo, 2000). From complementary perspective, learner support is all about providing access to both resources and opportunities that leads to lifelong learning (Reid, 1995; Smith, 2000). It extends the range and duration of services and emphasizes the importance of providing quality information, advice and guidance at pre-enrollment and early post-enrollment stages. Hardy & Boaz (1997) even extend the concept of learner support into the next level – "learner development" meaning preparation of the learners for a distance learning experience beyond the technical assistance.

What are the Elements of Learner Support?

There is an almost infinite variation in learner support systems in distance education, and as Sewart (1993) commented, each system is unique in a sense that it is dealing with a different student population in a different context. Thus developing a general yet representative framework of learner support has been a challenging task for researchers in this area.

One of the most comprehensive lists of elements of such a system was developed by Keast (Keast, 1997). He identified four distinctive types of support for distance learners - administrative support, instructional support, technical support, and counseling/tutorial support. This list is by no means exhaustive and misses library support, a very important category that is gaining growing attentions these days. However, it still captures key functions of learner support and most support services suggested by other researchers or practitioners fall under Keast's categories (Aoki & Pogroszewski, 1998; Frieden, 1999; Reid, 1995; Sache & Mark, 2000; Tait, 1995).

Each category will be further elaborated in the following section, and considering the special relevance to current emphasis on informational technology in distance education, library support will be added to Keast's four elements of learner support system.

Academic/Tutorial Support

Academic/tutorial support is largely based on Open University model in U.K. where students have access to local study centers and tutors who supervise their academic progress and help with problems (Watkins & Wright, 1991; Sahoo, 1993; Rae, 1989). In more recent web-based distance education programs, the focus of academic support gears toward facilitating collaborative learning and increasing interactivity between distance students and instructor or among distance students (Aoki et al., 1998). Some of the examples of such services include syndicate or learning groups, support by instructor on request, workshops to assist students to develop specific skills or bridge skill gaps, supervision support on research project, and "learning contract" and scheduling (SAIDE, 1998).

Administrative Support

Administrative support services involve maintaining basic program functions such as admissions, registration, course scheduling, student records, and financial transactions (Frieden, 1999). These services are often taken granted but when not planned carefully, they cause greatest frustration from distance students.

Technical Support

Technical support refers to monitoring efficient operation of delivery mediums and offering technical assistance. While much research has been conducted on the use of new technologies in designing and developing distance courses, less effort has been directed toward the use of new technologies to provide support services for such courses (Abate, 1999). Providing an 800 telephone number for students to contact the faculty and staff, requiring that all students have access to email and know how to use it, requiring faculty to schedule office hours particularly for distance students at times that would be convenient to the students (Reinert & Fryback, 1997), and it may be necessary to devote additional on-campus facilities to support the off-campus population.

Counseling Support

Counseling support includes various aspects of guidance and advising. In correspondence studies or other delivery medium with more individualistic interface, the focus of such services tends to be focused on how to deal with academic concerns and/or career advising. In many web-based distance education programs, counseling support also deals with ways to improve communication skills and increase interactivity, and even network with alumni and community building (Aoki et al., 1998).

Many institutions are also requiring orientation sessions that bring the students on campus in order to familiarize them with the services that are available. Such sessions would provide an opportunity to learn the interfaces used to access the services as well as a chance to interact with the support personnel on-campus (Thompson, Winterfield, & Flanders, 1998).

Library Support

Access to adequate library services and resources is essential for the attainment of superior academic skills in post-secondary education and distance learners are entitled to library services and resources equivalent to those provided for students in traditional campus settings. However, traditional on-campus library services often fail to stretch themselves to meet the library needs of distance students.

The Association of College and Research Libraries (Libraries, 1998) provides a guideline for distance education programs to ensure that library support meet the students' needs in fulfilling course assignments (e.g. required and supplemental readings) and accommodate other information needs as appropriate. Some of the specific examples of library services to meet those needs include region-wide

borrowers cards, consortia membership between academic libraries, and fax and online capabilities for the timely document delivery (Aoki & Pogroszewski, 1998).

In a review of the literature on distance learning library support, Stephens (Stephens, 1996) stressed that what was lacking was not only books and journals per se, but instruction and the opportunity to do independent library research. To be able to fill this gap, distance library services need to be more customized and empowering distance learners, such as providing toll-free telephone numbers for library help desk and capabilities to use multiple databases and online public access catalog (Aoki & Pogroszewski, 1998). The combination of special funding arrangements, proactive planning, and promotion is necessary to provide such services (Smith, 2000).

Emerging Issues in Learner Support

Many researchers expected that advances in technology would make it easier to provide quality support services with increased interactivity and automatization (Bates, 1994). However, for all those dramatic changes in terms of delivery medium, from correspondence to audio and video conferencing systems, then to the Internet in nowadays, many issues are remained as same, if not technology adds another level of complexity. Some of them are more critical and have greater implications for future research than others, and thus they will be discussed in more detail in the rest of this paper. Those issues are: (1) the cost-effectiveness of learner support services, (2) the lack of empirical research and difficulties in generalizing the research findings as a result, and (3) the importance of learner-centered approach in learner support.

Cost-Effectiveness of Learner Support

The first issue is related to how to scale customized support services in a cost-effective way. In order to better meet the diverse needs of distance students, support services needs to be more individualized (Brent, 1995; Sahoo, 1993). Providing such services is not an inexpensive proposition, however, and the underlying assumption is that the greater the input to the provision of learner support services, the greater the completion rate and/or learning outcomes (European Commission, 1996).

At this point, there are few studies that offer guidelines on this area, and most of them are focused on cost analysis of technology infrastructure (Brent, 1999; Rumble, 1993, 1999; Whalen & Wright, 1999). Although those cost estimation studies do offer policymakers some insight into the types and range of costs associated with distance education program in general, we can only infer from this broader framework how much it will cost to provide certain support services.

One of the biggest challenges in approaching the cost-effectiveness of leaner support is that the relationship between the input and output is not straight-line equation, and as the level of support gets beyond a certain point, the curve of student success seems to be flatten out (Sewart, 1993). The fact that there are relatively few references to direct and indirect costs involved with various support services also make it even more difficult to measure the cost-effectiveness of certain support services (Tait, 1995; Wagner, 1999).

The issue of cost-effectiveness in providing learner support services is also related to the mission of institution. The range and standard of learner support service provided by an institution will be eventually determined by whether it is more concerned about services or making profits from offering distance education programs. The bottom line is, in any case, the basic services needs to be provided regardless of the costs to guarantee the quality of education, and for beyond that, it is totally up to each institution to decide whether or not to offer more services.

Cost-effectiveness of learner support is likely to be achieved when the support system is structured to do "more with less," and this requires some creativity for institutions. One such example of scaling student services is partnering with other organizations such as businesses and school districts (Hickman, 1999). This may be an appropriate method for providing quality services by providing broader access and cutting the expenses on support staff training and maintenance by delegating the services to the specialists.

Lack of Empirical Research and Difficulties in Generalizing the Findings

The second issue revolves around the dominance of pragmatism in research of learner support. There are almost infinite variations of learner support in distance education practice, and the choice and use of certain services among those numerous services is largely based on practicalities rather than research findings. This leads to a tendency that pragmatism outweighs empirical inquiry or research in the area of learner support, which is confirmed by Robinson (1995). Based on the review of previous research and practice in this area, he concludes that learner support is heavily contingent on local circumstances. There is nothing wrong with research informed by practice, and the contingent nature of learner support seems to prone to such 'how to do it' type of case studies. However, there are missed opportunities where we can further exploit this critical issue in distance education.

Christenson (1998) made an interesting argument on how empirical research in social sciences may be used to guide practice as a framework. In developing theory in the social science, researchers' desires to extend the application of the best observed practice often leads them to emphasis too much on observation with the expense of theoretical reasoning. I believe this may be one of the major problems associated with pragmatic research in distance education, since in a case study, the generalizability of findings and its predictive power is somewhat limited to the institutional boundary where the practice is emulated. Thus this type of research often advocates the status quo rather than advancing theories and seeking/predicting changes beyond what has been observed.

Each support system is unique in a sense that it is dealing with a different student population in a different context, of course, but even so, we can always use of a general framework or model for learner support that is grounded in learning theories and supported by empirical data. Without such a framework, every institution needs to learn what does and does not work for them at expensive cost – trials and errors. And it would not just the institution but also the distance students that have to pay the cost.

Need for Learner-Centered Approach

Last issue is related to the need for learner-centered or customer-focused approach in planning and implementing learner support. No one can understand the difficulties that distance learners encounter better than the learners themselves. Yet in many institutions offering distance education programs, learner support is based on top-down provision rather than analysis of learners' needs (Tait, 1995; Sache & Mark, 2000; Scalzo et al., 2000). It is not new to the field of learner support at all, and had already been clearly stated by D. Sewart (1987):

It does not seem unfair to suggest that there is an overwhelming tendency within the field to offer systems from the viewpoint of the institution teaching at a distance rather than from the viewpoint of the student learning at a distance (p.72).

Traditionally, education has represented a provider-led rather than a customer-led activity and the central question of identifying student needs were often neglected. In the past when distance education was viewed as a product, rather than a process, and the quality of learning was identified as the quality of learning material, institutions were able to operate successfully with the provider-led mindset.

However, things have been changed, and today's distance learners are much more sophisticated, diversified, and demanding than ever, and they expect a lot more than well-designed learning materials. Besides that, the competition among distance education providers is such that if an institution fails to satisfy the students, it will loose them to one of its competitors. Understanding learners are critical in providing appropriate support services for the survival of distance education institutions nowadays.

When incorporating a learner-centered approach in designing and implementing learner support, we have to understand that it is a continuous process, rather than one-shot activity. Different learners may have different needs, and those needs may be changed over time. Those differences or changes can only be traced by systematic and continuous efforts to identify, analyze, synthesize, and assess distance learners' needs.

Nunan (1993) suggests a user-pay system as a ways to meet diverse user needs and expectation. He believes that by generating choices and options that can be purchased according to the individual needs and interprets, an institution can achieve customization in a more cost-effective way. This can be an insightful resolution approaching learner-centered support services, but if it is not followed by accurate descriptions of each option and counseling services, the learner may not be able to make informed decisions to select what is best for themselves. Also, the institution should provide some of the most basic

services such as library support or technical support as default. Otherwise, it may sacrifice the quality of education at the expense of convenience or cost-effectiveness.

Suggestions for Future Research

Learner support in distance education needs to be justified not only pedagogically but also financially, and to be able to do so, research on learner support should support the following areas: (1) developing/refining the methods of cost-benefit analysis, (2) developing a general model of learner support in web-based, dual-mode institutions, and (3) providing a ways to systematically incorporate the needs of distance learners in designing and implementing learner support services.

There have been a lot of claims that providing appropriate learner support services would increase the quality of learning and would positively influence student retention and satisfaction. However, these claims were rarely accompanied by supporting data, which leads to the tendency that learner support services become vulnerable to financial fluctuation. The only way to deal with this issue is to come up with sound methodologies to measure the cost-benefit of learner support.

The framework suggested by Cuckier (1997) is promising in that it includes a 'value-directed' benefit dimension and thus more suitable for measuring the values added by intangible services as most learner support services. He proposed three types of benefit measures - performance-oriented, value-oriented, and value-added benefits, and it is believed that future research on learner support can benefit from applying his multi-dimensional framework.

Secondly, the learner support models based on correspondence programs and their underlying assumptions need to be tested under new web-based distance education programs in the future research. Large-scale, text-based distance education institutions such as Open University in the UK have well-grounded learner support systems such as tutoring, counseling, and advising, and have served as a model for learner support system in previous research (Tait, 1995; Singh, 1988; Sewart, 1993). However, dual mode institutions that are now developing web-based distance education programs are facing different challenges in establishing and standardizing administrative procedures and support systems to accommodate new technologies and diversified learner population.

Thirdly, future research needs to adopt learner-centered approach in designing and implementing learner support services and develop ways to identify, analyze, synthesize, and assess student needs and systematically adapt the support system to those needs. Thus future research should be able to utilize various methods to efficiently communicate with distance learners. Research on student attrition is believed to provide valuable insights to understand what are some of underlying hindrances or barriers in distance learning and thus help future research on learner support to better meet the learners' needs.

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EXPANDING THE HUMAN PERFORMANCE TECHNOLOGIST'S REPERTOIRE: KNOWLEDGE MANAGEMENT, ORGANIZATIONAL LEARNING AND HUMAN PERFORMANCE TECHNOLOGY LITERATURE REVIEW

Mary Ann Doucette
Concordia University

Successful performance improvement efforts draw from such disciplines as psychology and systems theory, and from the fields of instructional design and human resource development. Both knowledge management and organizational learning are valuable additions to the human performance technologist's repertoire for performance analysis and intervention selection. In this paper, I will discuss how the human performance technologist can augment human performance analysis and solution planning by drawing from knowledge management and organizational learning literature.

The concept of organizations as learning systems emerged at the beginning of the twentieth century. However; it was not until the 1990s that we witnessed an overwhelming interest in the impact of knowledge management and organizational learning on organizational performance.

Current research on knowledge management and organizational learning has dealt primarily with theory and model building. In addition to the empirical research, there is an abundance of literature based on the experiences of practitioners and facilitators working in these fields (Davenport & Prushak, 1998; Preskill & Torres, 1999; Hansen, Nohria, & Tierney, 1999). The existing literature represents the first step in a long-term research program. The second research phase began in the late 1990s. It involves the development and validation of survey instruments to diagnose and establish learning organizations; and empirical studies that test models and describe the processes and outcomes of knowledge management and organizational learning on organizational performance (O'Dell, Grayson, Jr., & Essaides, 1998; Yeung, Ulrich, Nason, & Von Glinow, 1999).

Knowledge management is a conscious strategy of getting the right knowledge to the right people in the right time, and helping people share and put information into action in ways that strive to improve organizational performance (O'Dell, Grayson, Jr., & Essaides, 1998).

The focus of most knowledge management literature is on knowledge generation, codification and transfer. Knowledge generation encompasses knowledge acquired by an organization as well as knowledge developed within it. The aim of codification is to put organizational knowledge into a form that is organized, explicit, portable, easy to understand and accessible to those who need it. An essential element of knowledge management, which is vital to the organization's success, is to develop specific strategies to encourage spontaneous, unstructured knowledge transfer (Davenport & Prusak, 1998). Nonoka and Takeuchi (1995) defined organizational knowledge creation as the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems. Similarly, DiBella and Nevis (1998) stated that organizational learning is a cycle of three processes: knowledge creation or acquisition, knowledge dissemination, and knowledge use.

In contrast, O'Dell, Grayson, Jr., and Essaides (1998) proposed a seven-step knowledge process (create, identify, collect, organize, share, adapt and use). Yeung, Ulrich, Nason, and Von Glinow (1999) offered a different perspective about the organization's capacity to learn. They proposed that an organization's fundamental learning capability represents its capacity to generate and generalize ideas with impact (change) across multiple organizational boundaries (learning) through specific management initiatives and practices (capability).

Attention has also been given to the sharing of tacit knowledge and explicit knowledge at the individual, group and organizational levels. Both tacit and explicit knowledge are the key dynamics of knowledge creation in the business organization (Nonoka & Takeuchi, 1995). Davenport and Prusak (1998) explained that knowledge that is explicit can be embedded in procedures or presented in documents and databases and transferred with reasonable accuracy, whereas tacit knowledge transfer generally requires extensive personal contact between individuals and groups within the organization. The process of knowledge sharing is necessary if the organizational interpretation system is to transcend the various interpretations of problems and solutions at the individual level (Walsh & Ungson, 1997).

Literature on current business practices indicates that consulting businesses employ two different knowledge management strategies - codification and personalization. The codification strategy calls for knowledge to be carefully codified and stored in databases where it can be accessed and used easily by anyone in the company. With the personalization strategy, knowledge is closely tied to the person who developed it and is shared mainly through direct person-to-person contacts. Companies that use knowledge effectively pursue one strategy predominately (80%) and use the second strategy (20%) to support the first (Hansen, Noirha, & Tierney, 1999).

Organizational learning is defined as an adaptive change process that is influenced by past practice, focused on developing or modifying routines, and supported by organizational memory (Nonoka & Takeuchi, 1995). The essence of organizational learning is members' sharing of experiences and learning together (Schwen, Kalman, Hara, & Kisling, 1998).

The organizational learning literature is primarily devoted to the development of new or different organizational structures that support the conditions for learning. Managing intellectual capital requires organizations to create and sustain an environment where employees want to contribute their ideas, innovations, and analysis, and which receives them willingly (Horibe, 1999). Tampoe (1996) states that a facilitative environment interacts with the individuals motivational drive and competence to release motivational energy. This motivated energy is directed into professional and personal achievement by ensuring that individuals have a clear sense of purpose and are sustained by access to information and peer contacts.

Conversely, Weick and Westley (1996) argue that organizing and learning are antithetical processes, which means the phrase *organizational learning* qualifies as an oxymoron. They state that to learn is to disorganize and increase variety, whereas to organize is to forget and reduce variety. Consequently, organization must be reduced in order to create conditions conducive to learning. When organizations are allowed to exist as self-organizing entities, then learning and knowledge come to the surface naturally, because survival depends on it (Cavaleri & Fearon, 1996). Lyles and Schwenk (1997) hold a similar view regarding structures that support organizational learning. In tightly linked or coupled knowledge structures, there is strong consensus among organizational members. There is greater rigidity in the sense they do not have flexibility in responding to environmental changes. However, loosely coupled structures incorporate more disagreement and alternative interpretations. Changes can be made easily since there is more flexibility in action taking and strategies.

Organizations build learning capability through a variety of processes. O'Dell, Grayson, Jr., and Essaides, (1998) promote the use of benchmarking between organizations and within the organization. Benchmarking is a process of systematically finding and adapting best practices in order to improve performance. A broader view of how organizations approach the learning process is supported by the research conducted by Yeung, Ulrich, Nason, and Von Glinow (1999). They argue that there are four different styles of organizational learning: experimentation, competency acquisition, continuous improvement and benchmarking. Competency acquisition and continuous improvement are the most popular learning styles based on survey findings, yet experimentation has the most positive effect on business performance.

In terms of best practices, many successful organizations have abandoned hierarchical structures, organizing themselves in patterns specifically tailored to the particular way their professional intellect creates value (Quinn, Anderson, & Finkelstein, 1996). In inverted organizations, the former line hierarchy

becomes a support structure. Some organizations have created intellectual (spider's) webs in which people are brought together quickly to solve a problem and then disbanded just as quickly when the job is done.

An applied field whose aim is the achievement of valued human performance in the workplace is human performance technology. Human performance technologists adopt a systems view of a performance gap. They systematically analyze both gap and system, and design cost-effective and efficient interventions that are based on analysis of data, scientific knowledge and documented precedents in order to close the gap in the most desirable manner (Stolovitch & Keeps, 1992). Foshay and Moller (1992) describe human performance technology as an applied field of practice that is structured primarily by real-world problems of human performance (in the workplace). It draws from any discipline that has prescriptive power in solving any human performance problem. It also may draw from other applied fields when they contribute technologies of use in solving human performance problems.

Performance analysis is a process for defining the business need and isolating root causes of problems within existing systems or for identifying opportunities and constraints in the introduction of new structures, systems or machines (Brandenberg & Binder, 1992). Primary interventions used by human performance technologists include: training, job aids, feedback systems, employee selection, and organizational technology (Foshay & Moller, 1992). Schwen, Kalman, Hara, & Kisling (1998) add that the human performance technology analysis process involves collecting data and information that can lead to the discovery of new knowledge and make tacit knowledge salient, and the solutions may involve interventions related to two or more root causes, and integrated interventions such as relevant information data bases, coaching and mentoring, and modification of related rewards and incentives.

Some common themes have emerged in the literature with respect to knowledge management, organizational learning and human performance technology. Knowledge management involves three main processes: generation, codification and transfer of knowledge. While explicit and tacit knowledge are necessary for organizational learning to occur; it is recognized that because tacit knowledge is hard to articulate in formal language it is also more difficult to disseminate and transfer. The organizational learning literature indicates organizations that have developed structures and strategies that nurture and support learning have experienced improved performance despite the rapid changes facing organizations. Human performance technology relies on thorough performance analysis to identify all factors contributing to the current level of performance and to propose alternative interventions that will eliminate the cause of the performance discrepancy.

Another trend that is emerging in the literature involves the contribution of knowledge management to the field of human performance technology. Rossett (1999) outlines that knowledge management perspectives can influence analysis. Analysts would provide learners with a knowledge management resource that provides meaningfully organized data elements. To develop this resource, the analysts must capture an array of diverse experiences and examples, and include rich commentary that assures a deeper experience for users when they choose to review both the knowledge element and people's ideas about it. Schwen, Kalman, Hara, & Kisling (1998) state that the knowledge management literature gives linking concepts to human performance analysis (i.e. making tacit knowledge explicit, identifying hidden needs) and solution planning (i.e. capturing expert's knowledge, mental models).

The knowledge management literature states that tacit knowledge is hard to articulate in formal language and it is also more difficult to disseminate and transfer. During the performance analysis process, the human performance technologist must find ways to make this tacit knowledge explicit. In addition to the standard data-gathering tools (observation, interviews, surveys, and extant data analysis), the human performance technologist could employ critical incident analysis to draw out the tacit knowledge. Critical incident analysis is used to elicit *war stories* by asking individuals to describe, in terms of behaviour, what exactly they had done (correctly/incorrectly). During the intervention planning phase, the human performance technologist must take into consideration that explicit knowledge can be embedded in procedures or presented in documents and databases and transferred with reasonable accuracy, whereas tacit knowledge transfer generally requires extensive personal contact between individuals and groups within the organization. Interventions such as classroom training, policy and procedures manuals, data base systems, and job aids are generally limited to the transfer of explicit knowledge. On-the-job training, under

the guidance of a coach or mentor, should be considered for transferring tacit knowledge that is closely tied to the person who developed it ,or which is shared mainly through direct person-to-person contacts.

Both knowledge management and human performance technology literature focus on competencies (knowledge and skills) required for individuals to perform their work and to enable the organization to maintain its competitive advantage. It is becoming increasingly important for organizations to attract and retain competent individuals with exceptional talent. Human performance technologists should examine what organizations have in place, or should have in place, to further develop each individual's knowledge and competencies, and to support each individual's ability to contribute to the organization's objectives.

Individuals search for knowledge because they expect it to help them succeed in their work. Individuals learn within the organization when they acquire knowledge through education, experience or experimentation. Attention should also be given by human performance technologists to identify which learning style (experimentation, competency acquisition, continuous improvement, or benchmarking) organizations employ. Since organizations learn from both direct experience and the experience of others, the human performance technologist will need to look at intervention designs that enable the system and culture of the organization to retain and transfer knowledge from individuals. In this way, organizational learning will be embedded in the organization's routines, technologies, policies and procedures, and in patterns of behaviour that continue to exist despite turnover of individuals.

The literature on organizational learning indicates that managing intellectual capital requires organizations to create and sustain an environment where employees want to contribute their ideas, innovations, and analysis, and which receives them willingly. During the performance analysis phase, the human performance technologist should study the organizational structure and job requirements to determine the extent to which the organization allows for the existence of naturally occurring learning events. In order to plan appropriate solutions, the human performance technologist should investigate how the organization enables individuals to access knowledge that has been codified and stored in documents and databases, and how it fosters personal contact. Personal contact can be achieved through on-the-job training under the guidance of a coach or mentor. Alternatively, organizations could form action learning teams or employ intellectual (spider's) webs in which people are brought together quickly to solve a problem and then disbanded just as quickly when the job is done.

Future endeavors in research should provide empirical evidence of the value of knowledge management and organizational learning to organizational performance. As stated earlier in this report, the study of knowledge management and organizational learning is currently moving towards broad-based, empirical research. The knowledge gained from this research will enable human performance technology researchers and practitioners to implement interventions based on tested models, and proven processes and outcomes of knowledge management and organizational learning.

There is also a need for human performance technology researchers to apply paradigms for research that will be both effective for theory development and appropriate to the settings of human performance technology practice. Human performance technology by its nature excludes use of experimental paradigm on practical, ethical and methodological grounds. However, researchers will find descriptive or investigative (case studies) most useful research paradigms. If researchers and practitioners take the time to reflect systematically on their experience, it will be possible to expand the empirical base of the field (Foshay & Moller, 1992).

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THREE APPROACHES TO TEACHING THE SAME SUBJECT AT TWO UNIVERSITIES

Ellen Taricani
Penn State University

A collaborative effort was established between two major universities to teach a particular subject. The course was taught 3 different ways: full collaboration, half collaboration, and a traditional method. This paper will discuss the methods used and why it was implemented and organized in this manner.

Background to the Course

In the fall of 1997, a senior level course was taught as an interdisciplinary class for learning the processes in food product development. The course implemented many new teaching methods and technologies. It was an effort between two departments: food science and agricultural economics. Students worked in teams with industry mentors who assisted in elaborating on some of the procedures involved in the development process of food products. It was intended to take this class beyond the walls of Penn State in the Fall of 1998 and include some other locations. An opportunity arose to link up with students in a food marketing class in St. Joseph's University. This opportunity included finding ways to share resources and for the students to get involved with each other. Speakers were shared and some collaborative work was done during the 1999 year using PictureTel. The classes were scheduled for the same time of day to facilitate cooperation.

Fall semester of 2000, it was decided to take the process a step further and truly integrate the teams for working on projects and assignments. Teams were formed to work together o n the course project. There were three different versions of the course. One course is totally integrated. The second version will share the speakers and have some lectures on the off days. And, the last one was left alone to be taught traditionally wi th lecture and few outside speakers or influences. All three used case studies to assist in the learning process. In all three cases the students were asked to create concept maps and take a mini knowledge test to be used in the evaluation process of understanding concepts before and after the course.

Aspects of the Fully Collaborative Course

There are several distinct features of the fully collaborative food product development course. The course was originally conceived to apply principles of constructivist theory. In this approach, prior knowledge and experience is the springboard for useful, personal knowledge construction. "Constructivist learning experiences and appropriate classroom practices include reflective thinking and productivity; authentic activities, including student collaboration and consideration of multiple perspectives, and student access to content area experts who can model domain-specific skills." (Grabe & Grabe, 1998) Course organization was based on the idea that the students would be able to reflect on situations and environments in order to make application towards the course project.

Jonassen (1996) also has much to say about constructivist learning environments. "Constructivist environments facilitate learning through collaboration, context, and construction of knowledge. Through assimilation and accommodation, individuals use many elements of the learning context and relate those elements to their own experiences thus creating new knowledge". Constructivism does not always produce predictable learning outcomes. Instruction should foster the constructive process of the learner, and not attempt to closely control the process or result. The process of instruction and role of instructor should be as a guide to discovered knowledge. There was not a specific result desired in the course rather a process that was to be fine-tuned. Contextual situations were provided with the case studies and industry speakers. The use of case studies was implemented to assist in developing critical thinking. Students were expected to apply prior knowledge and seek out new knowledge to fill in the gaps that may rise up as they worked through various case studies.

Objectives

1. To comprehend the fundamental principles, generalizations and theories of product development.
2. To understand the specific skills, competencies and points of view needed by product development professionals.
3. To appreciate the interdependencies of finance, formulation, marketing, packaging, process engineering, production and quality assurance in the development of food products.
4. To better understand how food company managers gain knowledge about the process for developing food products.
5. To develop skills in analyzing ill-defined opportunities and developing strategies to resolve them.
6. To develop the competencies of effective communication and negotiation skills when working within groups/teams.
7. To develop the ability to be a self-regulated learner who can engage in both constructive and critical self- and peer-assessment.
8. To enhance the ability to use contemporary communications and information technology. To enhance oral and written communications skills.

Use of Case Studies

Wilson (1996) defines a constructivist learning environment as: "a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities" (p.5). He emphasizes learning environments as opposed to 'instructional' environments in order to promote "a more flexible idea of learning", one which emphasizes "meaningful, authentic activities that help the learner to construct understandings and develop skills relevant to problem solving" (p.3).

Case studies have the capacity to engage students in the thinking process. Case-based reasoning is a cyclic and integrated process of solving a problem, learning from this experience, and solving new problems. The roots of case-based reasoning can be found in the works of Roger Schank on dynamic memory and the central role that a reminding of earlier situations (episodes, cases) and situation patterns (scripts, MOPs) has in problem solving and learning (Schank, 82). Each section of the case takes the student into new areas of cognitive exploration. Presenting the cases on the web as opposed to a written format provides the students with opportunities to explore and select particular information. Information that is presented without any direct and interactive activity will often pass right through their head without any processing or application. They are not likely to change the way they view a particular situation as a result of merely hearing the information. Due to the nature of most web pages, students' minds will race past topics in rapid succession with little time or opportunity to think, reflect or develop meaning. Their cognitive skills are only apparent on a scattered layer of thinking. They are forced to adopt a surface approach to their learning. Students are typically in a survival mode to read, memorize and reiterate the information in some sort of examination process.

Some of the problems of student understanding and learning can be enhanced through the use of alternative teaching approaches. This paper discusses a model used to promote critical thinking on the web using case studies. Aside from the basic issue of facilitating effective learning, there is a need to develop in students a method for problem-solving that will be useful in "real world" examples.

Interactive Aspects

Interactivity in the course invites the students to participate and become part of what is going on with the industry and the people influencing it. The cases were written for this class with the goals of instruction in mind. Each case had its own particular items that provided twists in the development process. Some gave the students very difficult decision points that required outside sources to gain more insights on the subjects. Students worked both individually, and, in groups to share ideas and solve the problems. Experts in the field were brought in through face-to-face presentations or over PictureTel

sessions. Email and phone calls were also used to give the students access to probe and investigate some of the key points in the case as well as questions related to their projects. Cases were shared with a discussion from both the instructor and student view.

Stimulating Learning

A great deal is known about factors that affect learning and in particular factors that facilitate a deep approach to learning. There are some specific methods that can be used to motivate students. Case studies provide the opportunity for critical thinking since they only provide part of the information needed to complete the exercises. Students will:

- formulate questions that relate to the current case
- construct knowledge while they are engaged in problem solving
- build on and diffuse what they already know
- have the opportunity to discuss, explain, write and reflect on the new knowledge
- experience some control over what, when and how they are learning
- have an opportunity to consider new possibilities
- receive feedback regarding their learning

Learners actively take knowledge, connect it to previously assimilated knowledge and make it theirs by constructing their own interpretation. Students will read a case with their own experiences and a cognitive structure based on those experiences. These structures can be valid, invalid or incomplete. The learner will reformulate his/her existing structures only if new information or experiences are connected to knowledge already in memory. The learner must actively construct new information onto existing mental framework for meaningful learning and problem solving to occur.

Selection of the Tools

Select appropriate online technologies such as video and audio conferencing, computer-mediated conferencing, Internet access, bulletin boards and news groups, and e-mail to support teaching and learning strategies. A short discussion of each tool and reasons to use them will follow.

TOOL	BENEFIT
Video and audio conferencing	Provides visual and audio cues
Computer-mediated conferencing	Initiate discussions
Internet access	A wealth of resources
Bulletin boards and news groups	Others interested in similar discussions
E-mail	Direct contact with teachers, students, and speakers

Tools to promote higher-order thinking should be used in this constructivist process. It is not only essential to place the students in a rich environment full of new technologies, but to provide a means and reason for using the tools. PictureTel was selected as a video conferencing method since both universities had access to it. It was used at least once a week in order to share speakers and provide access for group communication. CourseInfo was used as a course management system with advanced architecture that allowed for Web-based integration and administrative systems. This provided the framework for communication with the students and amongst the students. Students used the online system to have discussions and share information with other team members. Faculty used the system to post assignments and information.

Evaluation of Student Performance

Students were evaluated and the course grade assigned based on the following:

Individual Performance		Team Performance	
Final Examination	**15%**	**Progress Report: Oral**	**15%**
Peer Evaluation of Collaboration on Team	**20%**	**Final Report: Written**	**20%**
Participation	**15%**	**Final Report: Oral**	**15%**
TOTAL	**50%**	TOTAL	**50%**

The Final Examination (15%) is a description of the product development process for a specific food product opportunity. Peer Evaluation of Collaboration on Team (20%) is accomplished by asking students to rate their team members on eight different parameters and then to offer an overall weight by assigning the portion of a $10,000 bonus to be distributed to each team member. This evaluation will be done twice during the semester and at the end of the semester.

The Progress Report (15%) is a team-based oral presentation simulating the product development team's presentation of its plans to the firm's upper management for a 'go-no go' decision. The Final Report (35%) is their team's presentation of the food product innovation to retail buyers.

Aspects of the Partially Collaborative Course

The class in this partially collaborative course was taught at St. Joseph's University. It consisted of a combination of lecture, presentations, discussion and exercises. Guest presentations from food industry professionals were provided. The major emphasis of the course was on the new product planning process and to that end, each student was assigned to a student team. Each team took on the identity of a food processing company and was challenged to identify a new product opportunity, conceive a new product, and develop a launch program to support introduction of this new product to the supermarket trade. Both a written paper and a formal oral presentation were required of each student team. The final presentations were made to a group of retail category managers. The final presentations were held during the scheduled time for the final exam.

Course Objectives

1. To develop skills necessary to be a contributing member of a team.
2. To enhance oral and written communications skills.
3. To develop skills in analyzing ill-defined problems and developing strategies to resolve them.
4. To better understand how food company managers gain knowledge about the process for developing food products.
5. To comprehend the fundamental principles, generalizations and theories of product development.
6. To understand the specific skills, competencies and points of view needed by product development professionals.
7. To appreciate the interdependencies of finance, formulation, marketing, packaging, production and quality assurance in the development of food products.

Class Format

The class format consists of a combination of lecture, presentations, discussion and exercises. The instructor will endeavor to provide guest presentations from food industry professionals on at least a couple of occasions.

Assignments and Grading Policy

This course is primarily a team-based course. Each student had one major individual task – a midterm examination. The bulk of the grade was determined by the quality and completeness of the work on the semester project. The grade was determined as follows:

Midterm examination.................................40%
Individual grade on NPD project 50%
The project grade will be divided into two components, the preliminary presentation to the management committee (1/3) and the final presentation (1/3) and comprehensive team paper (1/3.)
Contadina case (special project)...............10%*

***If you opt NOT to participate in the Contadina special project, you will** need to complete a short research paper on a topic assigned by the instructor.

Note: The individual grade for team assignments will be the team grade multiplied by an index number which reflects the quantity and quality of your contribution to the team effort.

The project consists of several parts, including a (1) company review and assessment, (2) category assessment, (3) concept development and screening, (4) product development and testing and (5) introductory marketing program and launch plan. Class time will be used to discuss more specifics about the project and details on the midterm and the project. The paper is due at the time of the final presentation.

Aspects of the Traditional Course

The third course was taught in a more traditional mode. There were lectures, tests and a project. This class also participated in some of the PictureTel sessions with the industry speakers.

Course Objectives

1. To comprehend and apply the fundamental principles, generalizations and theories of product development.
2. To understand and apply the skills, competencies and viewpoints needed by product development professionals.
3. To appreciate the interdependencies of R&D, manufacturing, finance, marketing and sales in the development of successful food products.
4. To develop skills in analyzing and taking advantage of ill-defined opportunities.
5. To understand the risks and rewards associated with new food products.
6. To enhance personal skills: team work; oral presentation; written presentation; selling.

Grade Components and Weights

Semester Project: Written:	40%
Oral:	20%
Special Semester Project:	10%
Class Participation:	15%
Midterm Examination:	15%

Semester Project

The course has three major emphases: developing a new food product; selling the concept to top management; selling the product to the retail supermarket trade. Each student was assigned to a team. Each team will select and assume the identity of a food manufacturing company and will: identify a new product opportunity; conceive a new product; and develop a launch program to introduce the new product to consumers in coordination with the supermarket distribution channel.

Each team submitted a written paper of 20 pages or less, excluding appendices, detailing its new product development and launch programs. The paper was due on December 6. An in-process draft was due on November 21.

Each team prepared a sell-in presentation to be made to a panel of grocery category managers in December, exact date and place to be determined.

The Study

This study is primarily looking at the differences in learning using different teaching methods. The evaluation of the students was essential to measure those differences. There was a pre-test and a post-test to assist in analysis. Many methods were implemented that will be discussed.

Conventional Teaching

There are typical elements found in conventional teaching practices. The curriculum content is usually fixed and presented in linear and sequential ways. A path of learning is established and sequentially used for the course. Mastery of existing knowledge and concepts is sought before students are led to the next set. Typical activities involve learning tasks that are segmented and fragmented to make them more easily achieved. These can include reading and lectures relevant to each particular subject. The activities tend to lack any real life context and are usually presented in abstract forms bearing little relevance to settings beyond the classroom. In most cases, the teacher plays the role of the expert delivering knowledge to the learners. Learners act in passive modes working individually to complete the set tasks. Assessment of learning is done through pencil and paper tests measuring competency in the various elements of the curriculum.

Learners have frequently been found to be incapable of applying and transferring the learning to practical settings. Learning has been found to be temporary and short-lived.

Active Learning and Teaching Methods

For some time now, educational researchers, classroom teachers and curriculum developers have been exploring ways to increase the effectiveness of teaching programs and in particular, classroom learning. The learning theories have always suggested that what is needed is more active involvement of the learners in the learning process. Theories of learning have been developed which explain the way in which learning is achieved through knowledge construction. The integral role of communication between learners has been explored and the value of collaboration and co-construction of knowledge developed. At the same time, curriculum developments have moved from descriptions of the content to be learned to environments where outcomes of learning have been made discrete. The role of assessment has been recognized and given a more fundamental place in the learning process. The sum of these developments suggests a changed direction for educational planning.

Changed Roles for Learners

The first thing often observed about learners in an active learning environment is the degree of self-regulation and self-determination. Students are expected to search for meaning throughout the course through resources provided. Formal structures are removed and students are free to make their own connections and pathways. Some of these include:

- Freedom of Information

Information is provided in an open setting such as the web, speakers, case studies and the course faculty. A book is also used in this setting to provide examples and more detailed explanations. Much of

the information that was gathered by the students came from prior experience, discussions, web pages, speakers, interactions with the faculty and cross-institutional dialog.

- Active Learners

Students are encouraged to collaborate and work together. The environment is usually one of a shared learning space with learners attentive and receptive to others in the class. Students are asked to solve problems and ask questions. They are expected to work with the other students in their group to accomplish tasks.

- "Real-life" Activities

Activities in class encourage and support such strategies as problem-based learning, case-based learning and presentations from those in the industry. The concept of a classroom as a place of learning is expanded as the classroom loses it boundaries. Each case study was written with the specific goals of the course in mind. It was important to provide examples of the various stages in the food product development cycle so that the students could make application toward their final project.

Changed Roles for the Teachers

Teachers in active learning environments differ in terms of their roles and responsibilities. The differences appear in how they interact with their learners and how they manage and implement their learning settings. Some of these roles include:

- The Coach

Their role is that of a guide or a coach. They provide the learners with access to a variety of independent learning experiences. There are minimum times that there is a need for lecturing or other forms of teacher-directedness in these settings. The most active person in the environment is the learner and often the teacher is a spectator of learning shouting advice from the sidelines.

- Instructional/Learning Designer

The teacher will play a vital role in designing the learning activities and developing creative ways to involve the students. Instead of only considering what is being taught, the teacher has to be thinking of how it is taught and what the possible outcomes will be.

- Assessment

The move to an outcomes-oriented approach carries with it changes to assessment strategies. These strategies reflect how the learning is to be used. Some of these approaches include teamwork strategies, case study analysis, projects, presentations, and summary papers.

Summary

The three courses will be used to make comparisons in the teaching methods to find differences in outcomes for the students. Each course contains components of constructivism in the approach to teaching especially regarding the use of case studies. The major differences are the methods of learning and the involvement of the students in the learning process. Students will be surveyed at the end with another concept map and mini test to compare the results from the beginning of the class to the end. The knowledge presented was similar, but the methods used were extremely different. Some of the questions to be answered regard the depth and application of the concepts that are obtained.

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Computer-Based Tools to Support Curriculum Developers

Nienke Nieveen
University of Twente, The Netherlands
Kent Gustafson
The University of Georgia

Since the start of the early 90's, an increasing number of people are interested in supporting the complex tasks of the curriculum development process with computer-based tools. 'Curriculum development' refers to an intentional process or activity directed at (re) designing, developing and implementing curricular interventions in schools, colleges, or corporate education. The term 'curricular intervention' serves as a common denominator for curricular products, programs, materials (varying from teacher and student/trainee materials), procedures, scenarios, processes, and the like. A key issue and major challenge in curriculum development is how curricular interventions should be developed in order to achieve a satisfying balance between the ideals of a curriculum change and their realization in practice. This paper provides background information on the roots of computer-based tools for curriculum developers, provides an overview of those tools currently available in the USA and abroad (especially Australia and The Netherlands) and describes probable future trends.

1. Roots of Computer-Based Tools for Curriculum Developers

Many designers make use of tools or job aids providing design support in their daily work. A job aid is a collection of several kinds of conceptual or procedural information (for instance: glossaries of terms, guidelines, decision tables, checklists) that supports work. Over the years, many of these job aids have been combined into handbooks for instructional designers. According to Rossett and Gautier-Downes (1991), job aids may have major advantages for their users, such as:

- they are available at the moment individuals feel a need for them;
- they increase the chance that an individual has up-to-date information to perform a task, especially in case of a very complex and infrequently performed activities;
- they prompt individuals through difficult processes and decisions.

Computer-based technologies have not only influenced the domain of job aids. They have also impacted other types of external support, such as communication and training. Today's computer and networking facilities can even integrate these types of performance support. Instead of separately providing different ways of support to individuals, an electronic performance support system (EPSS) provides integrated information, advice and learning opportunities to improve user performance (Gery, 1991; Raybould, 1995). EPSSs are given many names, such as performance support tools (Carr, 1992), (integrated) performance support systems (Geber, 1991), embedded performance support systems (McGraw, 1995). But regardless of the terminology used, they all refer to a computer-based system which provides integrated support in the format of any or all of the following: job aids (including conceptual and procedural information and advice), communication aids and learning opportunities to improve user performance.

With the increase of the number of computers used at work, a growing number of computer-based tools for designers and developers in education and training have been developed at various places around the world. More efficient development processes, more effective learning programs and increasingly competent designers are all potential benefits that make these tools attractive to many designers and their managers. In addition to these assumed advantages, some criticism may also be found in literature. Firstly, the potential supportive role of these tools should be carefully judged. For instance, as the consultation of an EPSS is usually largely self-directed, certain capacities of the individuals who use the EPSS are required: they need to know what they do not know; value a high degree of control and be able to evaluate

the quality of the information, to name just a few characteristics. Not every individual possesses these cognitive as well as affective characteristics. Moreover, Clark (1992) suggests that in many dynamic work environments, individuals do not have the time to look for information in the job aids or learn from the CBT component of an EPSS. Developers of EPSSs and organizations who consider using these tools should take these potential problems into account.

2. Overview of Available Tools

In order to get an overview we examined the following available tools: GAIDA, QIPP EPSS, PLATO, MediaPlant, SimQuest, CASCADE-SEA, TeleTOP DST, Mercator, IDXelerator, AGD and GTE. In box 1 each tool is briefly introduced. For more information please refer to the references of each tool.

GAIDA: Guided Approach to Instructional Design Advising (GAIDA) offers on-line elaborated guidance for the application of Gagné's nine events of instruction (e.g. Gagné, Briggs & Wager, 1992) to the design of interactive courseware and other instructional materials. GAIDA was developed for novice instructional developers at the Air Force Research Laboratory (Gettman, McNelly & Muraida, 1999).

QIPP EPSS: This tool supports the application of a new development methodology (called Quality Information Products Process) for designing technical documentation at NCR. The system specifies phases and work activities of the instructional design process and provides job aids for each activity. Technical writers and instructional designers of NCR belong to its main target group (Jury & Reeves, 1999).

Plato Courseware Development Environment: Plato is an authoring tool to support the design and development of courseware including tutorials, simulations and constructivist learning environments. The systems can be used by non-programmers to author instructional activities by customizing objects that are copied from a library and assembled into completed multimedia components. For each phase of the process there are job aids accessible to all members of the design team (Preese & Foshay, 1999).

MediaPlant: This is a development environment that facilitates the production of complex cross platform learning environments. The development program is used to construct and test the learning environment, which is then distributed with the runtime program (Wright, Harper & Hedberg, 1999).

SimQuest: This is an authoring environment for creating learning environments that combines simulations with instructional support that helps learners in the process of discovery learning. An author (teacher) creates a learning environment by adapting building blocks selected from a library. The author gets support from an on-line help system, a wizard and an advice tool (de Jong, Limbach, Gellevij, Kuyper, Pieters & van Joolingen, 1999).

CASCADE-SEA: CASCADE-SEA (Computer Assisted Curriculum Analysis, Design and Evaluation for Science Education in Africa) aims to support curriculum development within the context of secondary level science and mathematics education in sub-Saharan Africa. One of its components is called "lesson builder". This component has been designed to help teachers make paper-based exemplary lesson materials. Based on input of the user, Lesson Builder's prompt the program to generate a draft (McKenney, 1999).

TeleTOP DST: The TeleTOP Decision Support Tool is a WWW-based environment that helps instructors become aware of technical possibilities for their courses and helps them to see how these could be integrated in an educationally useful way (Collis & de Boer, 1999).

Mercator: This system supports the design, production and delivery of course materials. On the one hand it helps to design and produce the material, and on the other hand it helps students to select specific materials and supports the actual delivery in a printed and/or electronic mode (Valcke, Kirschner & Bos; 1999).

IDXelerator: This authoring system automatically generates the instructional interactions required for the student to acquire a specific kind of knowledge or skill. The system has an author view (that supports the author) and a student view for delivery of the instruction (Merrill & Thompson, 1999).

AGD: Atelier de Génie Didactique provides a pedagogical design assistant to content experts in companies and university teachers in preparing lessons for distance learning settings (Paquette, Aubin & Crevier, 1994; Spector; 1999).

GTE: The Generic Tutoring Environment is focused on providing support for designing intelligent tutoring systems. The primary task of such systems is to integrate instructional knowledge in the system in a way that allows the system to adapt to learners just as expert teachers do (van Marcke, 1998; Spector, 1999).

Box 1. Brief description of computer-based tools to support curriculum developers

From the short overview in box 1 it becomes clear that available computer-based support tools for developers in the field of training and education can be classified in many ways. To analyze the tools in more detail we used a framework with the following set of attributes:

A. Type of output:

- Curriculum level (few lessons, product, course, collection of courses)
- Characteristics of results (target group, form, extensiveness)

B. Purpose and evidence of benefits:

- Purpose (transfer of knowledge and skills, improved task performance, organizational learning
- Evidence of claimed benefits (validity, practicality, effectiveness)

C. Type of development process supported and any underlying theory:

- Paradigm for engaging in education and training benefit (instrumental, communicative, pragmatic, artistic)
- Elements of systematic approach (analysis, design, development, implementation, evaluation)
- Underlying teaching/learning theory (behaviorism, cognitivism, constructivism)

D. Task support:

- Types of support (communication aids, job aids, training aids)
- Adaptability of support (outside the tool, inside the tool, inside networked tool, closed)

E. Intended user group:

- Expertise of user group (professional designer (ISD), subject matter expert, teacher, learner)
- Scope of intended user group (various organizations, specific organization)
- Computer experience (low, high)

The framework was used to examine the tools for developers mentioned in box 1 (see Table 1). The framework should be judged solely on its utility as a schema for examining and selecting from among tools and is not intended to be a scientifically valid taxonomy. Moreover, it should be noted that the analysis is based on limited information provided by the developers of the tools and is not based on personal experience with most of the tools. For an individual who wants to select a tool based on the information in the framework, technical issues such as needed operating system, software; and hardware would be critical to consider as well. The same is true for other issues such as time needed to learn the tool; time needed until a user starts to be productive with the tool; the costs of a tool; and its general availability.

		GAIDA	QIPP	PLATO	MediaPlant	SimQuest	CASCADE-SEA
A	Curriculum level	Product	Product	Product	Product	Product	Course and lesson
	Characteristics of results	- Learner-based - Site-specific - Paper-based/ Computer-based	- Learner-based - Site-specific - Paper-based	- Learner-based - Generic - Computer-based and Web-based	- Learner-based - Site-specific/ Generic - Computer-based	- Learner-based - Site-specific/ Generic - Computer-based	- Learner-based Teacher-based - Site-specific - Paper-based
B	Purpose of tool	- Better transfer - Performance improvement	- Better transfer - Performance improvement	- Performance improvement - Organizational learning	- Performance improvement	- Better transfer - Performance improvement	- Better transfer - Performance improvement - Organizational learning
	Evidence	Results available	Results available	Results available	IIA	IIA	IIA
C	Development paradigm	Instrumental	Pragmatic	Pragmatic	Pragmatic	Pragmatic	Pragmatic
	Elements of systematic approach	- Design	- Analysis - Design - Development - Implementation - Evaluation	- Analysis - Design - Development - Evaluation	- Design - Development	- Design - Development	- Analysis - Design - Development - Implementation - Evaluation
	Teaching/learning theory	Behavioristic	Cognitivistic	Cognitivistic	Constructivistic	Cognitivistic	Cognitivistic
D	Types of support	- Job aid: toolbox	- Job aid: toolbox, do-it-yourself kit	- Job aid: toolbox, do-it-yourself kit - Communication aids	- Job aids: do-it-yourself kit	- Job aids: do-it-yourself kit	- Job aid: toolbox, do-it-yourself kit
	Adaptability of support	Closed	Inside networked tool	Inside networked tool	Inside tool	Inside tool	Inside tool
E	Type of user group	- SME's	- Designers	- Team with range of roles	- Designers - Learners	- SME's - Teachers	- Teachers
	Scope	Various organizations	One organization	Various organizations	Various organizations	Various organizations	Various organizations
	Computer experience	Low	Medium	High	Medium	Medium	Low

Table 1 continues

		DST	Mercator	IDXelerator	AGD	GTE
A	Curriculum level	Course	Course	Product	Course	Course
	Characteristics of results	- Learner-based, Teacher-based - Site-specific - WWW-based	- Learner-based - Site-specific - Paper-/Computer-/Web-based	- Learner-based - Site-specific - Computer-based	- Learner-based, Teacher-based - Site-specific - Computer-based	- Learner/based - Site-specific - Computer-based
B	Purpose of tool	- Performance improvement	- Performance improvement	- Performance improvement	- Better transfer - Performance improvement	- Performance improvement
	Evidence	Results available	Results available	IIA	IIA	N/A
C	Development paradigm	Pragmatic	Instrumental	Instrumental	Pragmatic	Instrumental
	Elements of systematic approach	- Design	- Design - Development	- Development	- Analysis - Design	- Analysis - Design - Development
	Teaching/learning theory	Cognitivistic	Cognitivistic	Behavioristic	Cognitive	Cognitivistic
D	Types of support	Job aid: automatic washing machine	Job aid: do-it-yourself kit	Job aids: automatic washing machine	Job aids: toolbox	Job aid: toolbox, automatic washing machine
	Adaptability of support	Closed	Inside tool	Closed	Closed	Closed
E	Type of user group	- Designers - Teachers	- Designers	- SME's	- SME's	- Teachers
	Scope	Specific organization	Various organizations	Various organizations	Various organizations	Various organizations
	Computer experience	Low	Medium	Medium	Medium	Medium

Note: IIA = Insufficient Information Available

Table 1. Conceptual framework

Here we provide a brief interpretation of the analysis.

A. Type of Output

In general, the use of most of the tools results in instructional products or courses that are computer-based and have learners as their main target group. Although it might be argued that many, if not all, of the tools could be used for creating many different forms of instruction, they do appear to lend themselves best to one or only a few forms of output. None of the systems seem to focus primarily on the development of interrelated collections of courses. Only a few of them may lead to paper-based materials (GAIDA, CASCADE-SEA and Mercator), and/or web-based materials (PLATO, DST, and Mercator) and only three tools support the development of teacher-based materials (CASCADE-SEA, DST, and AGD).

B. Purpose of the Tool

Generally speaking, all tools are designed with the expectation of improving the performance of developers of training and education. In describing the tools, some authors anticipate that their tool will lead to a better transfer of knowledge and skills to the actual task performance because it makes the rationale of the tool (and thus that of the design process) explicit (cf. QIPP, SimQuest, CASCADE-SEA, and AGD). Others expect that the use of their tool will lead to organizational learning, since the tool invites users to make newly acquired information available to their whole organization (PLATO and CASCADE-SEA). However, it should be noted that most of these claims appear to remain assumptions, since few data are available that demonstrate the actual benefits of these tools.

C. Type of Process Supported and Underlying Theory

Many tools that were analyzed make extensive use of a prototyping approach, which refers to a pragmatic paradigm. This is, with the exception of GAIDA, Mercator, IDXelerator and GTE: these tools seem to be based on a paradigm that follows a more linear completion of the instructional design process.

When looking closer at the underlying elements of the systematic approach to development of education and training it appears that two tools (QIPP and CASCADE-SEA) intend to support the designer during the entire process (from analysis through evaluation). All other tools support specific elements of the process, of which design and development get the most attention. When reviewing the tools with respect to the underlying teaching/learning theory, it appears that most tools are based (to various degrees) on a cognitivistic theory. Two tools seem to be based on a more behavioristic theory (GAIDA and IDXelerator) and one starts from constructivism (MediaPlant).

D. Task Support

All tools contain job aids to support users in their development activities. The metaphor of a toolbox and a do-it-yourself kit fits most tools. None of the systems that were analyzed have the ability to automate the entire instructional design process. In all cases, considerable human skills are needed to make effective instructional products and courses. It is noteworthy that none of the tools seem to include explicit learning facilities for designers who express a need for learning a specific design task. For novice designers, with the possible exception of GAIDA, the tools seem to count on an informal learning process of learning-by-doing or some form of external assistance.

E. Intended User Group

Generally speaking, it appears the designers of all tools started creating the tools with a specific organization in mind. In an overall view, the tools are intended for one or two of the following user groups: professional designers, subject matter experts, teachers and/or learners. This means that the support tools need to contain (parts of) team members' expertise that would have been needed in times when the tool was not available.

3. Trends in Computer Supported Curriculum Development

In looking ahead, there are several trends that will impact the form and substance of future computer-based tools for developing education and training.

Supporting a Constructivist Perspective on Learning

The increased influence of the constructivist perspective on learning is impacting the design of computer-based support tools. From this perspective, learning requires active construction rather than acquisition of knowledge by the learner. As a consequence, the teacher will increasingly become a designer of learning environments that support the construction of knowledge of the learners. Also, teachers or trainers increasingly fulfil design roles in the context of innovative projects, in which they participate, often emphasizing their own professional development.

Increasing Array of Tools

The first tools were almost all created to support only one or a few tasks related to the curriculum design process. Although there are now some tools that support many different tasks, none are completely adequate for all tasks on different types of projects. What we now see is expansion in several directions: there is an increase in the number of tools that attempt to integrate multiple tasks, however, at the same time the number of single purpose tools for highly specialized situations is also increasing. Continuing advances in computers, digital processing, and communication technology will all add to the demand for a complementary set of development tools and support new features related to future design efforts.

Supporting Teamwork

Team efforts are increasingly critical to large scale, complex projects, especially those that will result in technology-based instruction such as multimedia or web-based course. As a consequence, computer-based support tools may be extended with communication tools that facilitate collaboration. In addition, anticipation of how the curriculum intervention will be implemented is of growing significance during the design process.

Supporting Networks of Designers

As individual designers gain knowledge and skill in using the tools they can more readily share this knowledge with other members of the design community to prevent these insights and skills from being lost to others or not be otherwise leveraged in the organization. Based on today's database and networking technologies, effective computer-based infrastructures may be developed which makes knowledge sharing and knowledge management more possible.

For all of these reasons, we believe the future of computer-based support tools is very bright. The emergence and expansion of tool creation and use that we have witnessed over the last ten years will pale in comparison to what will happen during the next decade. We have no doubt that future tools will be as different from current ones as current desktop computers are from their predecessors of ten years ago. Continuing advances in computers, digital processing, and communication technology will both add to the demand for a complementary set of development tools and support new features we can only dream about today.

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Influences of Concept Mapping and Learning Styles on Learning

Ellen Taricani
Penn State University

The effect of concept mapping with different levels of knowledge to assist those with different learning styles will be discussed. This paper will discuss the methods used to compare these influences and the differences in particular learning processes.

Concept mapping

Concept mapping is a technique for visually representing the structure of information, concepts and the relationships between them. They can be compared to road maps that help us find direction in the midst of numerous signs, roads, and other distractions. Substantial changes in the complexity of the knowledge structures take students beyond rote learning toward meaningful learning. Students using concept maps increase their domain knowledge (Ruiz-Primo & Shavelson, 1996) toward applications and assessments.

Concept maps are useful tools that help students learn about how they structure knowledge while supporting the process of knowledge construction or metaknowledge. In this way, concept maps help students learn how to learn commonly referred to as metalearning. A concept map requires the learner to function at all four levels of Merrill's (1983) content dimensions: fact, concept, procedure, and principle. Each of these dimensions identifies three performance levels: remember, use, and find. "Remember" causes the students to search their memory in order to reproduce or recognize a previously stored item. "Use" will require the student to apply some abstraction to a specific case. Use means to use a general rule to process specific information. Finally, "find" is the performance level that the student begins to derive or invent a new abstraction.

The concept map becomes an external representation presenting internal processes of information in structured graphs (Jonassen, Beissner & Yacci, 1993). It becomes a representation of the application of the dimensions of conceptual processes at different content levels. The nodes and links represent relationships between the concepts and demonstrate the depth of processing knowledge. Conceptual understanding can be described as the richness of interconnections and relationships made between concepts and the structure that organizes those concepts (Novak & Gowin, 1984).

Concept maps have been used successfully to promote learning. How do students internalize and organize readings, assignments and notes to prepare a concept map as a study tool for a test that evaluates different levels of learning? How do they process new facts, concepts, etc., to complete assignments and take tests? Can a concept map be a significant factor in facilitating different levels of learning? Will different learning styles affect the strategies used in creating a concept map and the follow-through when given a test on the subjects?

Learning Styles / Cognitive Styles

Attempts to describe patterns of information processing have led to the development of several theories in the field of educational psychology (Noring, 1993), but most commonly these approaches have been divided into two broad classes of learning styles (also called cognitive styles, see Kearsley, 1994), known as field dependent and field independent. Field dependent learners, the most prevalent, need to see each segment of instruction in relation to the preceding instruction and the overall aims of the course. Field independent learners, on the other hand, are apt to find their own structure in which to place the instruction and other, extraneous applications for the instruction. Whereas field dependent students learn best the material presented within its social context, field independent learners prefer a more clinical, analytical

presentation of material, and learn social material more as an intentional task than a natural response. In place of the external goals and reinforcements desired by the field dependent learner, the field independent student values knowledge for its' own sake, and often has a personal set of goals and rewards to strive for.

Differences in cognitive styles do not indicate differences in learning ability or memory (Witkin, Moore, Goodenough, and Cox, 1977). Cognitive styles indicate the preferences that an individual has for perceiving and processing information, not the ability to learn the material. Thus, students with equal learning abilities but different cognitive styles may experience different levels of success in the same environment.

Meaningful Learning

The idea behind concept maps was derived from Ausubel's theory of meaningful versus rote learning. Meaningful learning occurs when students intentionally attempt to integrate new knowledge with existing knowledge. A learner who attempts to integrate knowledge will most likely have a more extensive network of knowledge and therefore more retrieval paths. His subsumption theory involves reorganization of existing cognitive structures not development of new structures. A primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure on a substantive, non-verbatim basis. Cognitive structures represent the residue of all learning experiences; forgetting occurs because certain details get integrated and lose their individual identity.

Rote learning occurs because a student simply memorizes information with no attempt or motivation to relate that information to prior knowledge. Therefore, the rote learner will have a less extensive network than the meaningful learner and less retrieval paths between knowledge concepts. Concept maps are one way to foster and measure meaningful learning in the classroom as instructional, student learning, and assessment techniques.

Instructionally, concept maps foster meaningful learning by teaching the connections among course concepts. As a student learning tool, concepts maps promote meaningful learning by encouraging the students to generate their own connections between concepts. In terms of assessment, concept maps evaluate if and how meaningful learning is occurring.

According to Ausubel's (1963) Meaningful Learning Theory, we build meaning every time we establish substantive rather than arbitrary relationships between the study material and existing knowledge. When students encounter new material they approach it from a series of concepts and representations acquired from previous experiences. These experiences are used as instruments of interpretation that partially determine what information the students will absorb, how they will organize the information, what types of relationships they will establish among the pieces of information, what problem-solving techniques they will use, and so on.

This explains why the concepts do not represent the same for the teacher as for the student—the concepts have neither the same relevancy nor the same explanatory power. Ausubel argues that when discipline is taught, it fundamentally transmits this conceptual structure to the students.

The appropriation of complex structures of knowledge implies an understanding of them, and that understanding cannot be reached only by routine procedures. The acquisition and retention of a body of knowledge implies the assimilation of a body of conceptual meanings—the product of meaningful learning.

In Ausubel's words, concepts are acquired by progressive differentiation—that is, those concepts that are ordered in a hierarchy that progresses from the most general to the most specific idea. New information is assimilated into existing conceptual hierarchies in the cognitive structure. These modifications are not merely juxtapositions of concepts, because the final meaning of a structure is not equivalent to the sum of the parts—it forms a new structure.

In the psychological structure, a related process of integrative reconciliation occurs that allows knowledge to relate to the discipline and modify preconceptions or misconceptions, thus reducing fragmentation and making possible a reflective and critical attitude.

The existing structure of knowledge influences the capacity to interpret reality and to take part in it. It creates a framework that will open or shut depending on the individual's capacity to understand. This capacity to approach and solve problems depends on the density of meanings in the existing structure of knowledge. There will be dominant areas in which the effect from an experience is quite broad and for which the structure of meanings is exceptionally powerful, and there will be others in which precisely the opposite happens.

From this perspective, attending to the potential of the study material to develop thought skills implies two things. First, the knowledge must be organized with the discipline and its methodology following a hierarchical relation scheme that is part of the most general and most inclusive concepts of the material and advances toward the most particular. This descending cyclical sequencing allows us to put relief in different relationships that maintain the concepts among themselves. Effective linkage results in subsumption; that is, new knowledge is meaningfully joined with other knowledge in the student's cognitive structure. Second, it must facilitate the assimilation of concepts (the progressive differentiation and the integrative reconciliation) through:

- the initial presentation of general ideas that provide one conceptual framework for subsequent knowledge
- using specific examples in real contexts that illustrate the concepts and their relationships in such a way that they acquire meaning and feeling
- the combination and the sequence of positive and negative examples that facilitate the conceptual differentiation
- representation of the knowledge in graphical systems, such as the concept maps, that help better understand the relationships among the ideas and the procedures

Progressive dfferentiation is presenting the most general and inclusive ideas first, followed by increasing detail. Integrative reconciliation is pointing out similarities and differences between old and new learning. Cognitive strategies are skills that may aid the learner in an internal process of attending, selective perceiving, coding for long term storage, retrieval and problem solving.

Concept mapping is a technique for visually representing the structure of information—concepts and the relationships between them—and can therefore aid the student in the process of meaningful learning. Concept mapping is also designed to encourage the mapper to make his or her own connections among knowledge concepts. The more meaningful connections a person can show in the map, the better s/he will understand the material. The process of mapping a map and the final product are dependent on prior knowledge, context, and constructed understanding.

In constructivism, active and meaningful learning is encouraged as an educational philosophy. Learning is a structuring process where knowledge is derived from experiences. Ausubel argued that learning new materials depends greatly on the existing cognitive structure or what the person already knows. New information will be more easily learned if it is explained and also related to relevant ideas in the student's cognitive structure. Meaningful learning occurs when new information is linked to prior information in the learner's own cognitive structure. New information is more meaningful if it is related to existing knowledge.

The basis for this active learning role can best be described in Ausubel's (1963) theory of cognitive learning. Ausubel's principles of non-arbitrary assimilation of knowledge through concept differentiation and concept integration have become the fundamental principles for meaningful learning theory (Wandersee, 1990). Meaningful learning theory is based on these principles:

1) knowledge is stored hierarchically in idiosyncratic cognitive structures;

2) prior knowledge influences new learning, although misconceptions are acquired early and are resistant to
change;
3) humans construct new concepts and propositions through meaningful learning;
4) meaningful learning is at one end of a learning continuum with rote learning at the other

Component Display Theory

Component Display Theory (CDT) classifies learning along two dimensions: content (facts, concepts, procedures, and principles) and performance (remembering, using, and generalities). The theory specifies four primary presentation forms: rules (expository presentation of a generality), examples (expository presentation of instances), recall (inquisitory generality) and practice (inquisitory instance). Secondary presentation forms include: prerequisites, objectives, helps, mnemonics, and feedback. Merrill (1983) explains the assumptions about cognition that underly CDT. While acknowledging a number of different types of memory, Merrill claims that associative and algorithmic memory structures are directly related to the performance components of Remember and Use/Find respectively. Associative memory is a hierarchial network structure; algorithmic memory consists of schema or rules. The distinction between Use and Find performances in algorithmic memory is the use of existing schema to process input versus creating a new schema through reorganization of existing rules.

Component Display Theory is concerned with teaching individual concepts or principles, classifies objectives on two dimensions, and formats instruction to provide learner control. Component Display Theory is composed of three parts (Merrill, 1983):

- A performance/content matrix that includes the desired level of student performance (Remember Instance, Remember Generality, Use, and Find) and the type of content (Fact, Concept, Procedure, and Principle)
- Four primary presentation forms: Expository (Rule, Example) and Inquisitory (Recall, Practice)
- A set of prescriptions relating the level of performance and type of content to the presentation forms

Instruction will be more effective if all three primary performance forms—remember, use, and find—are present for the different types of content or information types. Primary forms can be presented by either an explanatory or inquisitory learning strategy. The sequence of primary forms is not critical provided they are all present. A concept map can be used to provide examples of the concepts as the learner elaborates on that particular concept.

Principles of CDT

1. Instruction will be more effective if all three primary performance forms (remember, use, generality) are present.
2. Primary forms can be presented by either an explanatory or inquisitory learning strategy
3. The sequence of primary forms is not critical provided they are all present.
4. Students should be given control over the number of instances or practice items they receive.

Using concept mapping provides a form of both remember and use. Students are asked to apply what they are learning as they draw the map. The generality is applied in the testing process. They are given control over their instances as they create their individual maps. Knowledge objects can be linked via component relationships: an entity can be a part of another entity, an activity can be a step of another activity, or a process can be an event of another process. The learner acquires knowledge of discriminating properties and is able to sort instances with respect to these discriminating properties. CDT identifies strategy prescriptions for different kinds of learning outcomes. Components of instruction provides a way to more precisely analyze subject matter content and more precisely design instructional strategies to present this material. A significant aspect of the CDT framework is learner control. This idea enables

learners to select their own instructional strategies in terms of content and presentation components. In this sense, instruction designed according to CDT provides a high degree of individualization since students can adapt learning to meet their own preferences and styles.

Two types of knowledge are part of the levels of learning that Merrill describes. Concepts are categories of experience bounded by a definition and given in a name. They are groups or classes of things that have something in common. Concepts are arbitrary groupings that are invented by people. This is displayed by key terms, items, processes, and categorizing items. An important consideration for learning concept classification is prior knowledge. Robert Gagné (1985) has shown that the skill of applying a concept always has some "prerequisite" skills, skills that must be mastered before it is possible to learn any given classification skill. A principle is a relationship among factors. It is composed of two or more concepts having an ordered relationship to each other (Gagne, 1971). Students display this knowledge by applying the principle. Some examples are: control, predict, infer cause, explain, troubleshoot, vary the task based on new conditions. There are two phases to learning a principle at the application level. The learner needs to comprehend the principle. This is referred to as the acquisition phase. After it is acquired, the learner needs to learn to generalize it to new situations, which is called the application phase.

The instructional sequence to be used is based upon performance levels designed by Merrill. His model suggests that the instructional sequence should include application and examples of each order of learning: remember, use and find. This involves establishing an instructional strategy for each phase. I will add another tool, feedback, to the sequence to improve learning.

Order	Instructional sequence
1. remember	Provide the learner with examples that lead to an expectation of successful accomplishment of the skill
2. use	Give learners the responsibility to practice and use the new skill in a supportive learning environment
3. find	New examples will be added to the concept maps
4. feedback	Provide feedback through expert maps to learners on how to improve their concept maps based on instruction on concepts and principles

This Study

In this study students were asked to create concept mapping and some were given feedback and instruction to assist in their knowledge integration. Effects of different treatments were established with the students to compare the differences with feedback and extra training on knowledge application. After reviewing the literature and issues raised, the researcher has concluded that the use of concept mapping can assist students in separating information and organization of it for recall. Concept mapping does assist in learning and developing skills for meaningful learning. However, does learning concept mapping with instruction on concepts and principles with feedback result in more learning for field dependent learners? Does a field independent learner do better without feedback on concept mapping and instruction on concepts and principles since they tend to favor less structure? The purpose of this study is to determine if more learning takes place when using concept mapping with instruction on concepts and principles, with or without feedback. In addition, the purpose of the study is to determine if field dependent learners tend to do better with structure, framed by instruction on concepts and principles, than field independent learners.

Summary

Concept mapping is tool that can be used for facilitating learning and assessing meaningful learning. It helps in gaining better and more comprehensive understanding of learning information. This study will attempt to determine if using concept maps will have a significant effect on both concept-type

and principle-type learning. Concept maps serve to clarify links between new and old knowledge giving an opportunity for the learner to externalize the links through test taking. In conclusion, this study will look at what can be done to help students create more effective concept maps using treatments such as instruction on concept mapping and instruction on concepts and principles, with or without feedback, to assist them in better learning techniques.

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VIRTUAL RESOURCES CENTERS AND THEIR ROLE IN SMALL RURAL SCHOOLS

Cândido Varela de Freitas
University of Minho, Portugal
António Pedro da Silva
Elementary School of Ponte de Lima, Portugal

Abstract

Virtual resources centers have been considered a pedagogical tool since the increasing development of electronic means allowed the storage of huge amounts of information and their easy retrieval. Bearing in mind the need for enhancing the appearance of those centers, a discipline of "Management of Resources Centers" was included in a specialized diploma course run at the University of Minho (Portugal) for in-service primary teachers. As a final work for that course, one of us (A. Silva) developed a virtual resources center about Ponte de Lima, which can be easily accessed through the Web site meanwhile created – (http://www.pontedelima.com). The center has not merely educational purposes; it also has in mind simple local information useful for tourism or even to get native people, living outside, in touch with their motherland. We describe the way the site was conceived and how its main areas developed; additionally, wc present some statements of users, looking for understanding of how they benefited from this tool now at their service.

Introduction

Since the mid-sixties Portugal has adopted deliberately an educational policy where instructional technology played a significant role. Although at this time the country was ruled by the retrograde dictatorship of the Prime Minister Oliveira Salazar[9], some signs of openness regarding the education could be noticed, specially concerning the principle of extending the education opportunities.

Portugal is a mountainous country, particularly in the Northern part. There are hundreds of very small villages that stand sparse in the valleys and even in the mountains. At this time, the road network was a very bad one. One of the wiser decisions of Oliveira Salazar was to build small elementary schools (grades 1-4) throughout the country, even in the smallest places. However, while the first four years of schooling were assured, the subsequent years were not, be cause of the distance to a major center and the extreme poverty of the people living in distant villages, who could not pay additional housing expenses. This was the main reason why most students did not take further courses at the secondary schools.

In 1965 the Government decided to set up the IMAVE (*Instituto de Meios Áudio-Visuais de Ensino* – Institute of Audio-Visual Means for Teaching) and also the *Telescola* (TV school). The *Telescola* started running courses by television to provide students in rural schools two more years (5-6) of schooling, that is to say, extending from four to six the number of school years. The design of *Telescola*, as well as its implementation, was a very good one. Besides the short lessons by television in each school an elementary teacher acted as a monitor, adding some direct teaching to the televised one. As is said in an OECD evaluative report, showing high regard for the Portuguese innovation,

> [i]t was altogether unexpected that out of Portugal should have emerged the only well established example in Europe of an integrated learning system, in which television played a central instructional role, covering the full curriculum at 'first-cycle secondary' level, and dealing with tens of thousands of children (OECD, 1977, p. 2).

[9] Oliveira Salazar was the Prime Minister of Portugal between 1928 and 1968, and ruled the country as a dictator. His successor, Marcelo Caetano (1968-1974), though more moderate, followed the main lines of Salazar's policy and was overthrown by the 25th April 1974 Revolution (the Revolution of Carnations).

The *Telescola* certainly was the most evident exploit in instructional technology in Portugal. At its peak tens of thousand students followed yearly its courses. Still today the *Telescola* continues to serve some villages where it is difficult to implement post-elementary schools. Of course Portugal is not today as it was in the 1960's. On the one hand, most small villages lost young population and today there are no children to go to school: some hundreds of primary schools closed. On the other hand, road conditions improved a great deal, and the isolation was broken for a majority of places.

However, it is still difficult to teachers living in small villages to cope with the lack of information and pedagogical materials they need in their everyday life. Teachers recurrently complain about their situation; they want and they deserve to have much more support. Several strategies have been thought of to minimize the poor conditions teachers face in the rural world. Once more technology seems to be the best way to reach such a goal: the Internet may help those teachers, due to the establishment of virtual resources centers.

What the Literature Says

Resource centers are not a novelty: even in the older schools, some educational materials were kept, having in mind their re-utilization by teachers and students to improve the learning process. In the beginning, however, school libraries stood as the main documentation centers. As the audio-visual materials developed, school libraries became true school media centers, keeping together books and other script materials with films, slides, audio and videocassettes.

In 1972, the American Association of School Librarians (AASL) acknowledged the shifting times, deciding to change the name of the AASL journal, *School Libraries*, to *School Media Quarterly*. In a rejoicing article, "A title for the times", Srygley reports us that "[f]or more than twenty years AASL has given strong leadership in defining the school library as a media center, learning resources center, or instructional materials center" (1972, p. 16). Therefore, we can assume that almost thirty years ago the label "resource center" came to the everyday life of schools.

The development of computer technology determined that even the professionals who were reluctant to admit a "library" keeping materials other than books and journals, should change their minds. In 1983, Koskiala summed up the new librarian point of view: "Nonprint is beginning to be given serious consideration in some accredited programs" (1983, p. 309).

The role of media specialists is going to change, and fast: in an examination of the impact of the new information age on education, Considine told us the sincere statement of one administrator, saying that "media specialists were an endangered species, threatened with extinction because they were neither visible nor viable" (1985, p. 182). He added: "For media specialists to survive such a threat, they must change not only their role but the perception many teachers and administrators have of that role" (1985, p. 182). Later, Schiffman (1987) wrote about the "window of opportunity" open to the school library media centers, entering in the online environment, to change public education.

Other authors (e.g., Craver, 1986; Dede, 1985; Ely, Blair, Lichvar, Tyksinski, & Martinez, 1996) drew readers' attention to the effects of the computer explosion, affecting schools and libraries (or media centers). It is notorious that these fifteen years (1985-2000) brought more changes to technology than those that occurred in the past 85 years!

All this means that the conditions to move forward were created. If powerful networking is available, if the storage and retrieval of information becomes easy for anyone, if communicating instantaneously with any part of the world is possible, then, why not have virtual resource centers?

In the 1980s the challenge of new information technologies (NIT) stimulated many contributions that made clear that the future of libraries (or learning centers) depended on the way these institutions were able to deal with those technologies. A new concept of literacy is implicit: besides reading and writing, the knowledge of using the computer is indispensable (Breivik, 1985; Horton, 1983; Hubbard, 1987).

However, it is only in the 1990s that the idea of a "virtual library" (and "virtual resource center") solidifies. Books and journal articles were published throughout the decade clarifying concepts, discussing principles and proposing models (Butler, 1991; Butterworth, 1992; Kurzweil, 1993; Rooks, 1993; Saunders, 1993; Blake, 1994). Most were cautious, announcing the potential of the new format but lowering the expectancy levels. Some of them decided to act as futurologists and we do not know whether they were right or wrong.

The Situation in Portugal

The first great impact of NIT into the Portuguese school system dates from the mid-eighties, when the Ministry of Education launched a specific program called MINERVA[10]. The objectives were "to develop teaching about computers and learning with computers, with adequate teacher training" (OECD, 1986, p. 22). It had a modest start, considering the budget and the number of schools involved (about 50 secondary schools), but its developments were much more promising. When the project ended, in 1992, 1,172 schools of different levels of education had participated in MINERVA, more than 50,000 teachers had attended in-service training and more than 100,000 students had attended classes or workshops regularly (Ehrmann, Somekh, Withers & Grandbastien, 1994).

In addition, the teachers who were participants as monitors kept from the project a great élan, and most of them completed university degrees in the field and continue, in their schools or elsewhere, to disseminate what they have learned.

The University of Minho had been one of the centers where MINERVA had grown up. Among the teaching staff from the education field but also from the computer science field there existed a strong feeling about the need for developing continuously the pedagogical approaches to NIT use. Therefore, nobody was surprised when, in the late eighties and the beginning of the nineties, the University of Minho set up several post-graduate courses on educational technology, first at master level, then as specialization for elementary teachers.

At this time, elementary teachers were certified after a three year course (corresponding to a bachelor's degree). The post-graduate course consisted of two years of study (thirty five credits). The students who performed well in a final exam, which consisted of the defense of a mini-dissertation, got the degree of "licenciado", a degree that is popular in Europe but does not exist in the United States.

Those courses were restructured in 1997, and since then the NIT course (now denominated "Information Management and Educational Communication") offers a discipline of "Management of Resource Centers". This discipline aims to provide students with the appropriate knowledge and skills to deal with school media centers. As the proponent of the inclusion of the discipline in the curriculum, one of us (C. Freitas) assumed its teaching. His background situation analysis can be synthesized as follows.

In Portugal, elementary schools (the students enrolled in the course were elementary teachers, as it has already been said) are very diverse in their formats: a few are big ones, mainly in important towns, as Lisbon or Oporto, a few are very tiny, as happens in rural regions (some schools have just two or three students!), and most of them are middle sized. By and large, first because of the immigration (mainly in the 1960s and 1970s), then because of the decreasing rate of births in the country, a strong diminution of students in schools became a reality. Because of that situation, new legislation was enforced regarding schools administration. Small schools were invited to reorganize themselves to find partnerships, building groups of schools ("agrupamentos"), that is, schools joined under the same administration in spite their physical distance, which normally is not a substantial one.

Each school has its own equipment and educational materials; most schools have small libraries. The new administration logic challenges the way equipment, and learning resources, have to be used. It is not surprising that the idea to join up the different schools made very clear the need for a new way to make more effective the existing resources: therefore, little by little, some resource centers have been created.

It was decided to introduce in the discipline some discussion about the role the Internet plays in the dissemination of information and the emergence of true virtual resource centers. One of us (A. Silva), even before the course he was taking, was developing a web site about his mother land, the beautiful and historical Ponte de Lima[11], a town about 30 kilometers distant from Braga. He decided to make some arrangements to transform his site into a virtual resource center to serve educational purposes, although it aims also to reach tourists and other people interested in the historical town.

[10] MINERVA stands for Meios INformáticos no Ensino: Racionalização, Valorização, Actualização (Means of INformatics in Education: Rationalization, Valorisation, Actualization).

[11] Ponte de Lima means "The River Lima Bridge". The town still has a very extensive Roman bridge, which is one of the most beautiful in the country.

The Virtual Resources Center of Ponte de Lima

A. Silva, in his final report (1999), evoked Negroponte. Negroponte several times drew our attention to the effect Internet could play in disseminating information (v.g., 1995, 2000). The development of his idea comes first from the passion for computers and the Internet.

The WWW allows teachers and students to create their own resources and learning environments. However, much more important than the act of creation itself is the potential of such documents to become available to many other people – mainly other teachers and students – but virtually to any human being who uses the Internet. The information generated through the Internet is always accessible, sometimes much more easy to retrieve than in a library, as happens on consulting an encyclopedia or a dictionary on line or downloading pictures and texts.

As it was said, Ponte de Lima is an old town (population: c. 2500). It is the chief-town of the "concelho" (the Portuguese word that stands for county, although the dimensions of most "concelhos" are undersized in comparison to the U.S. counties). The "concelho" has 51 "freguesias" (Portuguese word meaning a small village), with a total of 44,000 inhabitants (Figure 1). Almost all "freguesias" have an elementary school and some of them have two; the number of elementary schools is 61. Ponte de Lima and three other villages possess post-elementary and secondary schools. Ponte de Lima also has agricultural schools, one at the secondary level and other belonging to the polytechnic network (higher education). There is at Ponte de Lima a private extension of a University, the Fernando Pessoa[12] University.

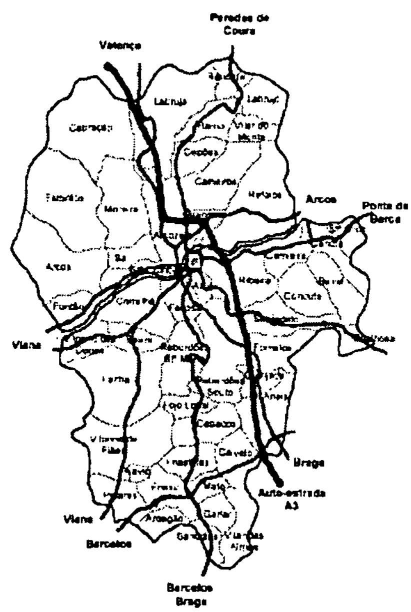

Figure 1 – Map of the "concelho" de Ponte de Lima

The number of students enrolled (1998-1999 data) is approximately 8,000; the number of teachers is 567. The dispersion of elementary schools isolates teachers in their schools. Sometimes, they have difficulty in find the materials they need for their classes. Although each school has a minimum of resources, it is impossible to provide each school with everything it needs. A virtual resource center could help those teachers and their students very much.

Since 1998, following a deliberation from the national government, all Portuguese schools have been equipped with the latest generation of computers and on RDIS line. The first schools to be equipped were the secondary ones; all the elementary schools will have computers by the end of 2001. This does not mean that many elementary schools do not have computers today; many local authorities

[12] Fernando Pessoa was the most representative Portuguese poet from the century XX.

anticipated the government deliberation and supplied some of the schools under their jurisdiction with machines.

This case, the concretization of a virtual resources center to assist those schools made sense. The design of the center, however, also contemplated other kind of concerns A. Silva had in mind: as a local native, he could not forget his fellow-citizens working abroad or people interested in learning more about Ponte de Lima. Consequently the design of the Web site reflected the several publics expected to visit it: teachers, students, emigrants, and tourists.

The visit to the Center shows seven basic themes:

- Access,
- History,
- Villages,
- Folklore,
- Nature,
- Utilities, and
- Pictures.

They are accessed through a navigation bar (Figure 2).

Figure 2 – Navigation bar

Each theme is divided into sub-themes. The theme History, for example, has the following sub-divisions:

- The origins of Ponte de Lima,
- The river "Lethes" myth;
- Characterization of the river;
- The bi-weekly market;
- The "Feiras Novas" (Portuguese words: New markets);
- The "Vaca das Cordas" (Portuguese words: the cow of ropes)[13];
- Monuments.

Every one of these sub-themes has plentiful documents, written texts, pictures, and songs. Obviously they have links to other themes, according to the logic of the construction.

We can find in this center such varied items as regional recipes, a complete statistical picture of all "freguesias" or the timetable for buses and how to call a cab. The quality of the images is very good, and some images picture dramatic events of the town's life (Figure 3).

With these documents, teachers can easily pick out those most relevant to their lessons. The site has the address http://www.pontedelima.com, or just http://pontedelima.com.

However, as some schools did not have Internet access, 200 CD are going to be distributed to all schools of the county, making possible the utilization of the Center by teachers without Internet. Bearing in mind the interest of potential tourists, there are envisaged English and French versions of the site. The problem, for the moment, is finding the appropriate financial support.

As a final requirement for the award of the diploma, the jury who appreciated this work congratulated the author. The Center has been constantly improved since then. It began as dependent on a large site; today it is emancipated, a "*dot com*" site.

On the other hand, the feedback coming from schools and teachers is very stimulating. One teacher who acted as monitor in a workshop, told us:

> The fact that we now have the site www.pontedelima.com was a very important event to Ponte de Lima ... it is a very pertinent tool, actually very useful for teachers and students ... it opens new perspectives, because it allows the utilization in the classroom, the teacher having all information needed about Ponte de Lima . . . [Personally], during a workshop about "Introduction to the Internet", I found this site was one of the most used, due to the format,

[13] It is a kind of bull-fight; a cow, not a bull, runs through the crowd secured by some ropes.

structure and variety of effects the Author was able to put in it. It is a good example of quality .
. .

Figure 3 – A flood – the river Lima reaches the town's houses.

A member of the teaching staff of the Fernando Pessoa University sent a short message:

> Congratulations on the Virtual Resources Center of Ponte de Lima. Thank you for the significant help you gave us for building our prospectus for foreign students.

From another point of view, A. Silva received several e-mails from abroad: the United States (Massachusetts), Canada, United Kingdom, France, Italy, Brazil, and Spain, among others. The Internet is doing its job, linking people in the world. One of those messages came from Poitiers, France:

> I am a French student (from a Portuguese family) ... and I am preparing a comparative study of Portuguese traditional tales and traditional tales from the region where I live, Poitou-Charentes ... Would you tell me if there are anthologies of tales from Ponte de Lima and its environment? ...

Therefore, the virtual resource center is working even outside the region where it was created.

Conclusion

It seems clear that virtual resource centers have a place in our school system, even though "real" resource centers exist. Consulting encyclopedias, dictionaries and databases around the world, visiting museums and exploring endless opportunities is something that can do much more for children than simple books and traditional lessons.

This experience, which we are trying to monitor better next year, when there will be computers in all classrooms, challenges teachers and students: we think that the time has come to jump from the timid use of new technologies as auxiliary of the teaching-learning process to the creation of stimulating, imaginative and supportive technological environments for both teachers and learners. Virtual resource centers could be one of the tools to work out such a challenge.

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Research Constructs in Distance Education: Interaction Online

David Winograd
State University of New York College at Potsdam

Interaction has been given number of meanings in the context of distance learning. Computer based training, which may require nothing more than clicking on a button, has been called interactive, as has instructional video and systems that allow voting or polling. It clarifies matters if the word interaction were taken to only refer to situations where a human response referred to a previous human response (Mason,). This is consistent with Daniel and Marquis' (1983) definition of interaction: "The student is in two-way contact with another person(s) in such as way as to elicit from them reactions and responses which are specific to their own reactions and responses" (p. 32), and Simpson and Galbo's (1986) definition:

> Behavior in which individuals and groups act upon each other. The essential characteristic is reciprocity in actions and responses in an infinite variety of relationships: verbal and nonverbal. . .Interaction is seen as a continually emerging process, as communication in its most inclusive sense. (p. 38)

Main and Riise (1995) conducted research to design a taxonomy of interaction that took into account dimensions such as amount, timeliness, method, and quality of interaction. Mason contended that interaction increases motivation, speed of assimilation of information, and length of retention of subject matter (Mason,). When students expressed what they had learned from a personal context and had offered differing points of view, critical thinking skills were developed as learning became deeper.

It has been widely held that interaction is critical to learning and an essential part of the academic process (American Distance Education Consortium, 1999; Berge, 1996; Hassenplug & Harnish, 1998; Kearsley, 1990; Parker, 1999; Phipps & Merisotis, 2000; Shale & Garrison, 1990b). Summers (1991) reasoned that without interaction teaching was reduced to "passing on knowledge as if it were dogmatic truth" (p. 14). This transferal model of learning eliminated any evaluation of the information transferred (Shale & Garrison, 1990a). Parker (1999) proposed that it is not sufficient for instruction to be transmitted linearly from instructor to student without interaction. "Today's distance education courses must authorize students to question their ideas and beliefs, thereby, encouraging provocative and interactive construction of personal knowledge" (p. 13). Peters (1999) concurred by stating, "If we take distance education seriously and understand it to be something more than the mere distribution of reading materials, we must provide sufficient opportunities for dialogues" (p. 13). Noble (1999) emphasized that along with a low student-teacher ratio, the one unquestionable mark of quality education is that there be significant interaction between two parties. Remmers (1995) maintained that without interaction there can be no education. The concept of "no interaction, no education" was used as an online global debate topic using a listserv at the University of Alberta, designed in New Mexico to be used as a pre-conference for the 1995 International Council on Distance Education in Birmingham England, summarized at George Washington University and Penn State demonstrating the potential of world-wide distance learning. This project produced an interaction analysis model for examining social construction of knowledge in computer conferences.

Years before CMC, Dewey (1938) made an eloquent case for the importance of interaction in education:

> There is, I think, no point in the philosophy of progressive education which is sounder than its emphasis on the importance of the participation of the learner in the formation of the purposes which direct his activities in the learning process, just as there is no defect in traditional education greater than the failure to secure the active co-operation of the pupil in construction of the purposes involved in his studying. (p. 67)

Moore (1989) defined three types of interaction found in distance learning: learner-content interaction, learner-instructor interaction, and learner-learner interaction. Moore considered learner-content interaction to be the defining characteristic of education because without content there is no education. This basic form of interaction can be one way. A student can interact with a book by reading it or with a videotape by watching it. Currently, learner-content interaction can be seen in computer-assisted instructional programs (CAI) where a student interacts with the contents of an instructional CD-ROM or program, which requires no intervention from an instructor.

Moore (1989) considered learner-instructor interaction to be highly desirable. The instructor motivates and stimulates the learner to enhance student interest and desire to learn. The instructor

organizes information that is then presented or demonstrated to the students. The teacher monitors and evaluates the students' mastery of the instruction, providing feedback and assistance. Depending upon the method of delivery, the student interacts with the teacher either with a great degree of frequency such as is possible in two-way video or computer-conferencing, or with a low degree of frequency in the context of a text-based correspondence course. This form of instruction is an individual dialogue between the student and the instructor without the benefit of a class of peers. Taking part in this form of instruction requires a great deal of autonomy on the part of the learner.

Learner-learner interaction takes place between learners either with or without the benefit of an instructor. Moore (1989) proposed that this form of interaction could be used to teach interaction itself but noted that the uses for it would vary depending on the situation, ages, experiences, and levels of autonomy of the learners. Moore contended that learner-learner interaction would challenge future thinking and practice.

Hillman, Willis, and Gunawardena (1994) proposed a fourth type of distance learning interaction: learner-interface. This type took the specific technologies used for distance learning into account adding another dimension. They proposed that the presence of interaction was a basic need for learning to occur and reinforced the importance of learner-learner interaction when they stated, "Regardless of content, however, instructors should take care to involve the learner in actively using the technology to communicate with other learners" (p. 38).

In the years since the four types of distance learning interactions were noted, research has been conducted exploring these modes of interaction. Powers and Mitchell (1997) in a study of an online course observed that students were able to develop rapport and provide support for each other. The instructor-learner relationship changed to reflect the instructor becoming less of a dispenser of knowledge as a community of learners developed. Similarly, Anderson and Garrison (1998) noted a shift in the balance of power when interactive online components were employed, and that a "learning community realized through learner-learner interaction need not, nor should not be absent from the distance education experience" (pp. 102-103).

Harasim and Yung (1993) in discussing a survey of 176 teachers and learners on the Internet reported differences found in CMC when compared with face-to-face instruction. They discovered that when online learner-learner group interactions greatly increased the ensuing discussions became more detailed and deeper. It was additionally found that personal communications between and among learners increased. Bruner (1971) added that much learning takes place in a social context through a mutual construction of understanding. Ahern (1995) in studying computer conferences observed that learner-learner interaction enhanced learning but also created "an important social environment wherein students engage their peers with talk that informs, explains, persuades, or even entertains. By providing the opportunity for authentic peer interaction, each student will develop an awareness of authorship" (p. 134). During a year - long faculty seminar on distance learning held at the University of Illinois, it was concluded that "an online course taught well creates a great deal of interaction between the professor and his or her students. There must be a great deal of interaction between the students themselves, especially in wholly online courses for placebound students" (University of Illinois Faculty Seminar, 1999, p. 31). However, Johnson, Aragon, Shalik, and Palma Rivas (1999) argued against including interaction in online courses. They proposed that online communication lacked a strong social dimension. The results of their study of student satisfaction in online and face-to-face courses warned that, "until the technologies for online instruction better simulate real time interaction, program developers need to avoid courses that require frequent socialization between the students and the instructor" (p. 21).

Interaction just doesn't happen. According to Kearsley (1990) extensive research insisted that "interactivity must be planned or it is unlikely to occur (or be meaningful). The idea that interaction must be explicitly designed in distance education seems a difficult concept for many instructors to accept or understand" (p. 8). Anderson and Garrison (1995) concluded,

> Merely acquiring and using the technology, without regard to the development of opportunities for regular and sustained interaction between and among users and learners, provided no guarantee that a critical community of learners would result. If critical thinking is a desired learning outcome, then learning activities that capitalize on the interactive potential of the medium must be planned and developed. (p. 42)

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PROBLEM-SOLVING IN A CASE-BASED COURSE: STRATEGIES FOR FACILITATING COACHED EXPERTISE

Donald A. Stepich
Northeastern Illinois University
Peggy A. Ertmer
Molly M. Lane
Purdue University

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This paper proposes the use of specific coaching strategies to facilitate students' use of expert-like problem-solving strategies while analyzing and solving instructional design case studies. Findings from an exploratory study, designed to examine changes in students' problem-solving skills as they analyzed case studies, suggested that students could show expert characteristics at times, under some circumstances, but did not perform like experts on a regular basis. Thirty-seven students at two midwestern universities analyzed six to ten case studies as part of their course assignments. Both quantitative and qualitative data were collected; students' written case analyses (initial conceptualizations and recommended solutions) served as the primary data source. Comparisons were made both within- and across-students, as well as across time, to examine patterns and changes in students' problem-solving approaches. Findings suggested that primary influences on the incidence of expert performance seemed more external than internal and might be more aptly characterized as "coached expertise." Specific suggestions are included for coaching the development of students' problem-solving skills within a case-based course.

Professional educators face a daunting challenge – preparing students to solve the kind of complex, ambiguous problems that they will encounter as practicing professionals. Unfortunately, we aren't always successful in meeting this challenge. For example, in a study by Dahlgren and Pramling (1985), physicians noted the need to reorganize what they learned in medical school from a focus on content areas to a focus on common clinical problems. In addition, engineers and business administrators noted that the theories they learned in school were often too simplistic to help in solving real-life problems. Julian, Larsen, and Kinzie (1999) lamented that "novice (instructional) designers frequently enter the workforce with an understanding of the ID process but without the knowledge base that can help them solve instructional design problems and develop solutions" (p. 2).

Increasingly, professional educators have turned to the use of cases in an effort to help students learn to approach problem situations in the same ways that practicing professionals do. Case-based instruction presents students with a re-creation of a complex situation (a case) and asks them to analyze and solve the problems through reflection and discussion (Allen, Otto, & Hoffman, in press). In case-based instruction the learning focus shifts from the explicit knowledge and skills that form the traditional academic curriculum to the development of active knowledge – what Whitehead called "wisdom" (1929). Active knowledge goes beyond simply recalling information to the ability to use that information to select relevant issues and solve identified problems. For example, students in law school will read a case study and participate in a dialogue designed to elicit the key issues and legal principles in the case. More than simply recalling information, the students are asked to analyze the situation as a practicing lawyer would (Williams, 1992). Similar methods have been used in both business and medical education for nearly 100 years (Albanese & Mitchell, 1993; Christensen, 1987).

Case-based instruction offers a number of advantages for professional education. Cases are thought to be more effective than didactic teaching methods because they (1) more accurately represent the complexity and ambiguity of real-life problems, (2) provide a framework for making explicit the problem-solving processes of both novice (student) and expert (instructor), and (3) provide a means for helping students develop the kind of problem-solving strategies that practicing professionals use. More specifically, case-based instruction can help students learn to:

- Focus on the big picture. Expert problem-solvers typically represent a problem in terms of an appropriate underlying principle while novices tend to represent the problem in terms of surface features (Bruer, 1993). In case-based instruction, knowledge is embedded within complex and ill-

structured problems. As a result, students have an opportunity to practice "spotting" the underlying issues and principles in authentic, relevant problems.

- Work forward from what they know. Experts often build on what they know, generating hypotheses and looking for information to test those hypotheses (Johnson, 1988). In contrast, novices tend to focus on what they don't know, looking for information to fill in the gaps. A case study, by necessity, presents an abbreviated view of a problem situation. Students are forced to do the best they can with the information that is available. Thus, they learn to frame problems in ways that will move them forward toward a solution.
- Simultaneously consider multiple factors. Experts are likely to consider the web of relationships and interactions that exist in the problem situation, while novices generally consider one factor at a time (Perez & Emery, 1995). Cases allow students to experience the "complex and dynamic forces" (Rowland, 1992) that operate within the kind of complex problems that professionals commonly encounter. Although individual students may initially focus on a single factor when analyzing a case, case discussions tend to bring all of these factors to the table. This, then, facilitates consideration of all factors in an interdependent manner.
- Generate tentative solutions. Both experts and novices generate solution ideas early in the problem-solving process. However, experts are more likely to modify or eliminate those solutions as additional information becomes available (LeMaistre, 1998). Case studies tend to involve more than one key player, each representing a unique perspective. With practice, students can begin to understand that each player has a legitimate voice. Students are encouraged to modify their initial solutions as information accumulates and different perspectives are heard, including the student's own perspective.
- Consider potential consequences and implications. Experts think through their recommendations more thoroughly than novices, considering how those recommendations might be implemented and what implications they might have (Rowland, 1992). As a part of the case discussion, students are asked to consider the consequences of their recommended solutions and to select the one with the greatest benefits and smallest risk. Students and instructors are encouraged to evaluate each other's recommendations and to challenge decisions based on their assessment of the consequences for all case players.

Case-based instruction seems to be a natural fit with professional education in the field of instructional design. Like other professions, instructional design is a problem-solving enterprise in which practicing professionals combine creativity with technical skills to solve complex, ambiguous problems. Also like other professions, instructional design educators are looking to bridge the gap between education and practice (Quinn, 1994; Rowland, Parra, & Basnet, 1995) using a variety of methods, including case-based instruction (Ertmer & Quinn, 1999). According to Julian et al. (1999), case studies can help instructional design students (1) draw connections between their emerging knowledge of instructional design and the complex demands of practice, (2) reflect on relevant theory and methods as they explore a greater number of design issues in a broader array of contexts, and (3) broaden their knowledge base as they collaborate with colleagues to identify effective design solutions.

In order to take advantage of the perceived strengths of case-based instruction, the authors developed an instructional design course in which the use of cases comprised the primary instructional method. Our original purpose was research. We planned to examine changes in students' problem-solving skills during a course in which case-based instruction was used. However, after several different offerings of the course, we found that we had learned more about our use of cases than about changes in students' problem-solving skills. That is, the changes in our application of case-based instruction appeared more substantial than changes in students' problem-solving approaches. Furthermore, as we continued to modify and refine our case discussion strategies, we began to identify techniques that seemed better able than others to facilitate more "expert-like" responses among the students. Thus, we began to consider ways in which we might more purposefully "coach" our students as they developed their problem-solving skills.

The purpose of this paper, then, is to describe our evolving use of case-based instruction within an instructional design course. Recognizing that few guidelines exist for how to coach the development of students' problem-solving skills using case-based instruction, this paper offers an initial set of recommendations, based on data gathered during three semesters of instruction (five different courses). The first section of the paper describes the context in which case-based instruction was situated, including the courses and the use of cases. The second section offers a set of guidelines for using cases as an instructional method in the education of instructional designers. Specifically, we present guidelines intended to help students use and develop the kind of problem-solving strategies commonly used by experts.

Context

In the spring of 1998, the first two authors co-taught an advanced instructional design course at a large midwestern university. One faculty member was serving in a visiting position while on sabbatical leave from another institution. The following two spring semesters (1999 and 2000), both instructors taught similarly structured courses at their respective universities. During the spring 2000 semester, the two courses shared a course Web site that allowed students to participate in shared electronic discussions.

Participants (n=37) were enrolled in advanced graduate (n=25), introductory graduate (n=7), or advanced undergraduate courses (n=5) in instructional design. All but one student volunteered to participate in the study. Two undergraduate students were dropped from the study due to incomplete data sets. Course assignments and procedures were the same for participants and non-participants.

Graduate students were enrolled in either an advanced instructional design course within an educational technology program or an introductory course within a human resource development program. Students in the advanced course had taken 0 - 7 previous instructional design courses. Although an introductory instructional design course was listed as a prerequisite, three students were admitted without the introductory course, having gained sufficient foundational knowledge from previous work experiences. Graduate students ranged in age from 24 - 51 years, with an average age of 35 years. Undergraduate students were enrolled in the second instructional design course within a human resource development program. Undergraduate students ranged in age from 21 - 24 years, with an average age of 23 years.

Students in all three courses had a variety of background experiences including retail sales, office work, classroom teaching (junior high, high school, community college, university), nursing, course development, engineering at a local manufacturing plant, and training (formal, informal, one-on-one settings). In general, undergraduate students had less course work and fewer relevant job experiences than the graduates.

Procedures

Students in each course analyzed six to ten instructional design cases as part of their course assignments. Case studies were drawn from Ertmer and Quinn (1999) and were used in conjunction with other activities (guest speakers, student presentations, project assignments, required readings) throughout the semester. There were no assigned textbooks in the advanced graduate course, although additional readings were frequently recommended or required. The introductory graduate course included an instructional design book by Smith & Ragan (1999) and the undergraduate course used a text by Kemp, Morrison, and Ross (1996).

Students in each course also completed: (1) an open-ended questionnaire describing previous experiences with instructional design and with cases, and (2) a self-assessment survey indicating levels of competency from 1 (weak) to 5 (strong) on sixteen instructional design skills. The self-assessment survey was based on the sixteen instructional design competencies outlined by the International Board of Standards for Training, Performance, and Instruction (IBSTPI, 1984). Students rated their current level of knowledge and skill on items such as: assess the relevant characteristics of learners/trainees (#3), develop performance measures (#7), evaluate instruction/training (#11), and promote the use of instructional design (#16). At the end of the semester, the self-assessment surveys were readministered to all participants.

Students participated in case discussions both in class and on-line. On-line discussions were facilitated via a listserv (spring 1999) or a Web-based bulletin board (spring 2000) and typically preceded the in-class discussions. While the listserv discussions extended dialog among the advanced ID students only, the Web-board discussions included students enrolled in both introductory and advanced courses at the two universities. Various techniques were used to initiate and facilitate the discussions including debate, role-play, and structured discussion. Regardless of technique, each discussion revolved around one or two basic tasks: (1) analyzing the problems and issues in the case and (2) recommending solutions for identified problems and issues.

Qualitative analysis methods were used to examine changes in students' case responses. Responses initially were coded using the five expert problem-solving characteristics (see pages 4-5), but modified to fit emerging themes and patterns. For example, initial codes were used to characterize students' <u>conceptualizations</u> of the case (reporting vs. interpreting), <u>searches for information</u> (absent vs. present information), attention to the <u>relationship among factors</u> (laundry list vs. coherent plan), <u>levels of commitment</u> to solutions (dictatorial vs. advisory), and consideration of the <u>implications of recommendations</u> (narrow focus vs. broad focus).

These codes were refined throughout data analysis and eventually combined into analysis and solution categories (see Appendix A for more detailed descriptions). Recognizing that problem-finding and problem-solving are two related, but different, skills, we examined students' analysis and solution approaches separately. We examined students' analysis approaches by looking at their conceptualizations of the issues, searches for information, and attention to the relationships among issues. We examined students' solution approaches by looking at their attention to the relationships among solutions, levels of commitment to proposed solutions, and consideration of the impact/implications of proposed solutions.

We assigned an independent rating to each student's analysis and solution response. If most of the components of a response were novice-like, the response was rated as "weak." If the response included a fairly equal number of novice and expert-like characteristics, it was rated as "mixed." Finally, if most of the components of the response were expert-like, the response was rated as "strong." This allowed us to 1) compare, within-students, analysis and solution approaches, 2) identify patterns of responses, across-students, that were specific to each case study, and 3) to identify patterns that developed or changed across-time.

Results

A two-tailed paired t-test ($df = 36$) indicated a significant increase in students' ratings of perceived competency for instructional design skills ($t = 8.30$; $p < .0001$) from the beginning to the end of the semester. Even though all 16 skills were not specifically addressed in the case studies used in the courses, students judged that their competencies had increased across skills (pre-test mean = 3.44, SD = .36; post-test mean = 4.15, SD = .21). However, this increase in perceived competency was not completely supported by corresponding changes in students' approaches to analyzing cases and recommending solutions. In general, students showed both strong and weak responses throughout the semester. In fact, sometimes students demonstrated a stronger response on an earlier case and weaker response on a later case. For example, when students' attention was directed to the potential implications of a solution, students were able to consider the effects of their recommendations, but they did not always do so on their own. As another example, when students were specifically asked to classify one or several issues in a case, their conceptualizations tended to take on a "big picture" approach. In contrast, if asked to simply describe the issues, students tended to respond with more surface-level reporting.

As we began to consider potential reasons for the uneven development and/or demonstration of students' problem-solving skills, our research focus shifted from an emphasis on what students could or could not do, to what we, as the instructors, did or did not do in our role as coaches. In an attempt to explain our "uneven" results, we reexamined our on-line case discussions to identify if, and how, specific coaching strategies may (or may not) have supported students' performances relative to each of the five characteristics of expert problem-solving.

In the section that follows we describe the specific coaching strategies we used to initiate the on-line case discussions during spring, 2000. Although we recognize that coaching can, and does, occur throughout a case debriefing, our discussion here focuses primarily on the case set-up as a critical starting point. Specifically, we examined the extent to which two expert problem-solving characteristics (conceptualizing the issues in the case and considering the impact of recommended solutions) were facilitated by the use of specific coaching strategies. Given the preliminary nature of these analyses, we judged that these two characteristics offered a useful starting point. First of all, these categories were fairly well defined and, thus, made identification and classification of students' responses more reliable. In addition, the two categories comprised both an analysis and a solution type, which we still considered to be relatively distinct aspects of the problem-solving process. In the next section, we describe students' responses to five different case set-ups: (1) structured discussion, (2) debate, (3) reflective practitioner, (4) role play, and (5) discussion chain. Each technique is considered in turn. (Note: Throughout the following discussion, participants in the ID courses are referred to as "students", whereas those who are receiving instruction within the case narratives are referred to as "learners.")

Structured Discussion

We used a structured discussion to initiate the on-line discussion for the Frank and Semra case. In this case, two U.S.-based instructional designers are faced with the challenge of developing a new curriculum to teach instructional design to trainers who work for the government of a southeastern Asian country. To begin, the instructors provided a one-sentence summary of the case, followed by three specific questions: (1) what do you think the learners' expectations of the new curriculum will be, (2) what kinds of adjustments do you think the learners will have to make, and (3) how might you facilitate these adjustments? Students were not asked, specifically, to discuss either the underlying issues in the case or the impact of their solutions.

Conceptualization of the case issues. As the first on-line discussion of the semester, this discussion starter seemed to lead to fairly structured responses. Almost every student (16 out of 18) answered each of the three questions, one by one. Perhaps because this set of questions seemed so structured, most of the students (10 out of 16) started by reporting or summarizing the facts in the case. However, even though students' primary focus seemed to be on reporting, 12 students included an interpretation of the case events, either separately or in conjunction with fact reporting. ["The learners need to see a need for change before they buy into a new system of design."] ["This is similar to a change initiative."]

Interestingly, our efforts to help students broaden their initial conceptualizations met with little success. Questions we asked during the discussion to explore the identified issues ["What is it about the culture issue that Frank and Semra should adjust to?"] did not generate any direct responses from the students. However, when another student asked whether the case provided sufficient reason to believe that a change should be made in the training methods being used (a common recommendation), other students added new interpretations of the issue ["Who is the client here? Who has the right to decide what is or isn't appropriate?"]. This difference in students' responses to instructors and peers may have been related to the timing of the case. As the first case, students may have felt some discomfort with this type of on-line environment or with responding to the instructors as participants in the discussion.

Students' consideration of the impact of recommendations. The three questions that opened the discussion asked students to make recommendations but did not ask them to explain the impact or implications of those recommendations. Additionally, the instructors asked few follow-up questions during the discussion and those that were asked generally focused on recommendations rather than implications ["Any thoughts about what Frank and Semra might do to make sure that it goes well with these trainers?"]. In retrospect, there were opportunities during the discussion to ask the students to explore implications (perhaps using questions such as "What effect might that have on the current trainers?") but, unfortunately, we failed to take advantage of these opportunities.

Predictably, students provided recommendations, often stated in specific terms ["I should convince them that the system approach is effective."] [" I will look for new or young trainers."]. However, there was little consideration of the implications of those recommendations. When students did consider implications, they were typically limited to a narrow focus on how a recommendation would solve the identified problem ["Once the interactive atmosphere is established, the losing face problem will not exist anymore."]. Little apparent thought was given to the broader impact of a recommendation, such as how it might affect other participants within the case or fit with other recommendations.

Debate

For the second case we facilitated an on-line debate. The Denny Clifford case is about a design consultant, with a traditional instructional systems background, who is hired by a science educator to create constructivist learning materials. As part of the set-up for this discussion, the instructors provided the following conceptualization: "This case raises some important questions about working with clients who view things quite differently from us." Students were then asked to argue whether or not an instructional designer should accept such an assignment. Students were assigned to one of the two positions and encouraged to engage in some "friendly competition."

Conceptualization of the case issues. In response to this set-up, almost every posting represented a conceptualization of why Denny should or should not take this job. Students were forced to support their positions, which led to a variety of sub-conceptualizations of the issue. Some students argued in terms of "comfort" or "stress" issues; others argued in terms of "risk," "challenge," or "growth possibilities." Because of this set-up, few students felt the need to cite facts from the case. Almost every student interpreted the case from the point of view they were assigned. The debate-style set-up seemed to be an effective way to get students to think beyond the facts of the case to the positive and negative sides of an issue. In addition, by providing a primary issue to chew on, the instructors modeled how to conceptualize issues in a case.

Students' consideration of the impact of recommendations. The debate format appeared somewhat successful in helping students focus on implications, especially among students who argued the "yes" position. Students explored implications from both a present and future perspective. In terms of present implications, some students noted that accepting the assignment would require additional work for both designer and client ["He may need to do a little extra work."] ["She may have to play a larger role in the process . . ."]. Other students included suggestions for increasing the likelihood of success on the assignment ["Perhaps Denny needs to talk to the people using Oakes' methods and find out how they are actually using them."] ["First, he can begin by identifying the aspects that he has in common with Oakes . . ."]. In terms of future implications, some noted that accepting the assignment

would help the designer develop his career ["Working with Oakes ... could open up even more doors for him to design for others and get him more jobs."] ["If he begins to limit his range of content and philosophies as a designer, he will be compromising his career."].

Reflective Practitioner

A reflective practitioner set-up was used with the Michelle Nguyen case. Michelle Nguyen is a designer/programmer working for a large medical center. She encounters a number of surprises as s he prepares to roll out a new product, carefully designed to reflect the requirements of a front-end analysis completed nine months earlier. In this type of case set-up, students were asked to assume the role of the instructional designer in the case, and, as a reflective practitioner, consider "lessons learned" from the specific experience. Rather than place blame on various stakeholders, students were encouraged to "move beyond" simply describing what happened to explaining at least one thing that would be important to do, or not do, the next time.

Conceptualization of the case issues. A reflective practitioner set-up forced students to prioritize the important lessons learned from the case. This took them beyond facts to their own interpretation of the important issues. For example, some of the lessons learned included 1) the need for continual communication, 2) revisiting steps in the ID process as you go along, and 3) having a backup plan for dealing with problems. The lessons-learned approach seemed to help students conceptualize the primary issues in the case in terms of important design processes and procedures.

Consideration of the impact of recommendations. The students explored the implications of their original "lessons" more in this discussion than in previous discussions. In addition, the specificity of the instructors' follow-up questions seemed to have an effect on the discussion that followed. For example, relatively general questions ["How do you think a focus group might have been helpful in this case?"] resulted in few responses from the students. In contrast, questions that were more specific ["But since a learner analysis had already been done, wouldn't this slow down progress on the project . . .?"] resulted in a discussion that involved as many as twelve different responses from the students.

Role Play

In two different case discussions, students were assigned roles to play and asked to view the case from that person's perspective. In the Haley Lawrence case, students were assigned a role and asked to "get inside that person's head" and identify the issues and concerns of that one person. Haley Lawrence is a case involving a variety of stakeholders within a client organization. Although Haley is hired to help the organization develop training materials for their sales representatives, she encounters several people in the organization who appear uncertain about her role and who find her presence threatening.

The Andrew Stewart case deals with the complexities and subtleties of integrating the contributions of different groups of stakeholders involved with a large design project. A secondary focus is on planning and completing a formative evaluation for a product that is still being developed. The case ends with the team in "crisis mode" as a deadline looms and the information collected, to-date, is unacceptable. In the Andrew Stewart case, students were assigned a role and asked to consider what they would do differently if they could start over and what they would do now, given the situation as it is.

Students were more active in these two discussions, possibly because they had participated in several previous case discussions, but perhaps also because of the safety of playing a role. Students could express themselves more directly and emphatically because they were presumably expressing the views of someone else (a character in the case). One result is that both discussions included virtual arguments between role players. ["To be honest with you, Mr. Sumida, you're changing the work contract on me." "Ms. Lawrence, you were brought in the picture to solve a problem not to create new ones."] ["It was not me who was trying to create new tasks. Instead I was trying my best to focus my tasks on our original contract."] Students tended to stay in character throughout the discussion, often responding to one another in the first person. ["Why should these be my problems?"] ["Don't put me in a bind."]

Conceptualization of the case issues. Despite an involved and intense on-line discussion, the Haley Lawrence role-play appeared only mildly successful at helping students frame and address design issues in the case. While students may have considered how one individual perceived the issues in the case, they did not work very hard, if at all, to understand each other's issues. Students enjoyed playing personalities, as noted earlier, but did not seem to move outside the personalities to consider broader case issues. However, in the students' defense, they participated in this discussion exactly as they were instructed. Had we encouraged them, sometime during the discussion, to switch hats with another stakeholder, we might have been more successful in moving beyond personalities to issues.

The second role-play set-up was primarily solution-oriented. Although students were assigned roles to play, they were told, right from the beginning, that they all shared responsibility for

the current situation. Thus, students refrained from blaming others, and looked for ways to help salvage the situation. As the role players considered their own responsibilities in causing the situation, conceptualizations emerged ["I should not have involved a group that wasn't as motivated about this project as the others."] ["I think that the major flaw in what happened had to do with communication."] ["I should have been more professional."].

Consideration of the impact of recommendations. Students did consider impact and implications in these discussions. On occasion, this included the practicalities of implementing suggestions that were made. ["You can have the St. Louis team send back the manuals on a weekly basis."] Typically, however, this was limited to a narrow view of how suggestions made by others affected their own roles. ["Why should these be my problems?"] ["If you could show me a little respect . . ."] Students seemed to have difficulty stepping outside of their assigned roles to see the situation more broadly or to acknowledge the perspectives of the other role players.

Discussion Chain

For the Sandra Hernandez case, students were asked to structure their discussion in the form of a chain reaction. The Sandra Hernandez case describes how an instructional designer, Jake Spaulding, was asked to help Sandra "fix" problems she was having with her freshman engineering lab. In order to help Sandra, Jake must balance a number of contradictory requirements and work within numerous resource constraints. For this discussion, one of the instructors started by describing what he saw as the most important issue and then proposed a solution. Students then were instructed to either agree or disagree with a posted comment. If they agreed, they had to add something to the comment; if they disagreed they had to pose a counter argument.

Conceptualization of the case issues. This type of set-up provided students with a model of how to conceptualize one issue in the case and then pose a relevant solution. By requiring students to add to each comment that they responded to, we forced them to consider other important issues that had been ignored or potential consequences of proposed solutions that had not been considered. Students looked for nuances in interpretation so that they could enhance or offer an alternative to a comment already posted. ["I don't agree that time is the main issue. I believe the main issue is what will be the best approach to teach the class...I'll consider time as one of many factors that are involved in the main issue."] Thus, conceptualizations were more complex than in previous cases, and evidence was typically provided to support specific conceptualizations. It is important to remember that this discussion occurred late in the semester, which may partially explain the increased complexity of students' responses.

Consideration of the impact of recommendations. The "ground rules" inherent in this type of set-up encouraged the students to think more directly about the implications of posted solutions. They could agree or disagree with a recommendation, but only after giving it some thought – what benefits or limitations did they see. One result was that students seemed to take a relatively broad view of a recommended solution. Sometimes this took the form of adding suggestions about how to implement a solution. For example, one recommendation was to have the lab already set up for the learners. Students added their thoughts about how to make this work. ["I can see this happening with the classes being divided into two sessions."] Sometimes it took the form of pulling in other issues. For example, another recommendation was to conduct the lab activities via computer simulation. Students discussed this solution in terms of cost ["Although this seems like a good solution, it's expensive and time-consuming."] ["If you cost out 80 students per semester, it would not take long to make this program cost-effective."], access ["Are there computers available for all of the students to have access?"], and instructional methods ["From the case, it seems to me that the experiments are a very 'hands on' type of procedure. I think computer simulation is not good enough for this type of experience."]. In order to agree or disagree with another person's comment, students had to carefully consider the many implications of a recommended solution. This, then, led to a fairly sophisticated understanding of the impacts of any single solution.

Coaching Guidelines

In general, students in our case-based courses perceived themselves as more competent at the end of the semester than at the beginning. However, the problem-solving strategies they used did not show the same kind of improvement. Students showed both strong and weak responses to cases throughout the semester, suggesting that their problem-solving expertise was not internalized. They could show characteristics of expert problem-solvers at times, under certain circumstances, but did not do so on a regular basis. The primary influences on their analysis and solution responses appeared more external than internal.

One of the external influences on students' responses was the way the case discussion was set up by the instructors. In the previous section, we described the coaching strategies we used to initiate on-line case discussions and the results that followed their use. Specifically, we related these results to

two expert problem-solving strategies: (1) the ability to conceptualize situations in terms of underlying principles rather than surface details, and (2) the ability to consider the impact and implications of recommended solutions in broad, rather than narrow, terms. In this section, we abstract from these results several strategies that instructors can use to guide their own coaching efforts. We have purposely described the strategies in broad terms in order to present strategies that can be applied through various techniques to cases in a variety of content areas. Where possible, we illustrate the strategies with examples from our case-base courses.

Coaching Students' Conceptualization of Case Issues

Strategy 1: Structure the discussion by giving students an initial role to play or a position to take in the discussion. In our case discussions we used debate, role-play, and reflective practitioner formats, all of which worked reasonably well as a way of implementing this strategy. Besides supporting students' conceptualization of the case issues, several other benefits appeared to result from using this strategy:

Safety. Students can present observations and opinions within the context of the assigned role, and not feel like they are exposing their own views to disagreement, ridicule, or evaluation. For example, during the on-line discussion of the Haley Lawrence case we asked students to play one of five characters in the case and to describe how that person viewed the case situation including his/her issues and motives. Students used a variety of creative approaches to express the thoughts, feelings, and opinions of their assigned character. One student wrote in a stream of consciousness, which enabled other students to read this character's innermost feelings and thoughts about the case. ["I can't believe Sumida didn't tell me about his task force and this list. Great, I see where this is going...When is Califano coming on board again? I can't wait until then, okay schedule an appointment with Katz..."] Another student summarized her response in the form of a memo to another character. A third student set the scene and then began sharing his thoughts on the case by talking to himself ["Sumida was smoking his last cigarette before going to bed, while reviewing a chapter of Covey's Seven Habits of Highly Effective People. He flipped over the open book on the table and he paused into thinking about his last meeting. The meeting scene was in front of his eyes, he started talking to himself and creating his own scenarios about the new project."]. The safety of responding from the perspective of an assigned role appeared to give students permission to respond both boldly and creatively, without fear of being criticized by their peers.

Starting point. The assigned role or position gives students some initial guidance and/or parameters that help them form their initial response. For example, when we began discussing the Denny Clifford case we asked students a single question: "The first question that needs to be addressed is whether it's even possible to design instruction for someone whose philosophy is diametrically opposed to our own – and when we don't really understand that other philosophy." We then asked half of the students to "present reasons why Denny should not try to work with Cynthia" and the remaining students to "present reasons why Denny should be successful working with a client with a different philosophy." The assigned position enabled students to engage in a lively debate as they argued both why Denny should take the job ["My opinion is that Denny Clifford should 'say yes bravely' to taking this job especially because he should remind himself that he is an independent consultant for a reason . . . that he must try to continually learn different philosophies of education so that he is able to innovate more instructional designs"] and why he should not take the job ["My position is that Denny Clifford should just say no to taking this job. He reminds himself that he is an independent consultant for a reason . . . that he can choose the jobs he wants to work on."]. In addition, being assigned a position that one didn't necessarily agree with encouraged students to consider strong arguments from both sides of the issue. This, then, provided them with a more complete view of the situation, allowing them to see that there were advantages and disadvantages to either decision the designer might make.

Multiple perspectives. Assigning different roles within a single discussion helps ensure that the viewpoints of different key players within the case will be voiced. This results in a broader view of the case. Following this, additional questions can be posed to compare and contrast the conceptualizations or interpretations of the case represented by the multiple roles. Returning to the Haley Lawrence case, each student played the role of one of the five characters in the case, which meant that several students were playing the same role during the discussion. Therefore, each character in the case had at least one voice in the discussion. During the discussion, the instructors can also help students move beyond their own role to see the viewpoints of the other characters ["So what exactly do you think is motivating his actions? And how can Lawrence get through to him and everyone else)?"]. However, this may need to take the form of explicit directions, as the students in our courses did not seem inclined to do this on their own.

Strategy 2: Begin the discussion with a structure, but avoid rigid adherence to that structure. It's important to remember that the instructor has two basic tasks in the case discussion: (1) setting up the discussion to create a dialog among the students and (2) facilitating the discussion to keep the dialog going. A flexible discussion structure helps with both of these tasks.

Creating a dialog The case set-up helps to "prime the pump" by providing students with an initial shared framework for thinking about the case and expressing their thoughts. For example, in the chain-reaction approach used for the Sandra Hernandez case we started the chain by (1) making a statement, (2) asking an open-ended question, and (3) presenting a set of ground rules for the subsequent discussion. Specifically, one instructor began the chain: 1) "I think the biggest problem here is the students' backgrounds. They just aren't ready for this course. To solve this problem, I think Jake should find a way to simplify the content of the course so that it is more in line with the academic background of the students coming into the course. 2) What do you think? 3) If you agree, you must add to the posted comment in some way. If you disagree, you must offer an alternative of some kind." By including both guidelines and an example of how to follow the guidelines, we jump-started the discussion and made it easy for others to jump in.

Maintaining the dialog Once the discussion starts and the ideas are flowing, the initial structure has served its purpose. In fact, students sometimes find it more constraining than facilitating. The instructor's tasks at this point are to help the students find the connections among the points being made and relate their discussion to the "big picture" issues in the case. For example, during the discussion of the Denny Clifford case, one student suggested an analogy to support her point. There were different interpretations of the analogy, which lead to a digression in the discussion. One of the instructors's maintained and refocused the dialog by looking beyond the analogy and posting a question. ["Christie's comment brings up ... two good questions: (1) Do you have to understand a philosophy in order to design instruction to teach that philosophy; (2) Do you have to subscribe to the philosophy in order to design instruction to teach that philosophy?]. In maintaining the flow of the discussion, it's important to remember that we want students to do more than just 'talk'; our primary goal is to maintain a focused discussion that continues to address the issues in the case.

Coaching Students' Consideration of Implications of Solutions

Strategy 1: Ask specific questions and limit the number that you ask During the initial set-up, it is possible to ask students to identify a problem, suggest a solution, and describe the possible impact of that solution. However, this may be too much for the initial set-up. It may be easier and better to explore these separately as the discussion progresses. When the initial set-up is too restrictive students do not have room to express their views and may feel that they are providing "answers" rather than discussing ideas. Once the discussion is going, however, students can more readily respond to specific questions about the impact of their recommendations on case stakeholders. Benefits of this strategy include:

Prevents students from being overwhelmed. A multi-part initial question may overwhelm students, especially if it appears to require specific answers. For example, we began the discussion of the Frank and Semra case with three specific questions, described above. The students were slow to respond to these questions, reporting that they felt overwhelmed by the number of questions and that they were concerned about posting "correct answers." In contrast, we began the discussion of the Andrew Stewart case by asking the students to discuss two questions from their character's perspective: (1) If you had to do it over again, what would you do differently? (2) Now that you're in the pickle you are in, what will you do next? This technique enabled students to jump into the discussion without feeling like they were overwhelmed or had to come up with the right answer. A result was that students joined the discussion more quickly and freely ["I obviously should not have tried to involve a group that wasn't as motivated about this project as the other participants..."] ["...If I had to do it over again, I suppose I should have reacted to my gut instinct when I saw the St. Louis team making faces. I'd forgotten how some designers think they know it all as soon as they land a nice paying job right out of school..."]. It is important to pay close attention to the manner in which a case discussion is opened; concern over "correct answers" is likely to stifle participation.

Creates open dialog among students. Asking specific questions encourages students to 1) respond to one another's problem identification, 2) suggest a solution to a problem described by someone else, or 3) describe the impact/implications of a recommendation made by someone else. For example, throughout the Sandra Hernandez case students actively responded to one another's answers using the "chain-reaction" approach and offered alternative perspectives on the impact and implications of the case. Students often responded directly to a person and posed additional questions ["Your consideration about the limited budget available is nice, but how could students 'collect data' without

conducting real experiments or computer simulations?"] ["I still disagree. How will the students' conduct the experiments if the equipment isn't set up? Will the students still set it up? If they do then the diagrams may use even more valuable time when the students study them."]. Having permission to disagree with each other's interpretations allowed for a rapid exchange of comments, each providing a new consideration of possible impacts.

Strategy 2: Look for opportunities to join the discussion, but participate carefully. As the discussion progresses, the instructor's primary responsibility is to maintain the dialog. To do this, it's important to continually look for opportunities to add questions and comments designed to help students see connections – to other students and to the big ideas that frame the case. At the same time, it's important to monitor the possible effects that your input may have on students. Students sometimes perceive comments from the instructor as the "answer," which may impede, rather than support, the dialog. In these situations, it is often better to resist the natural tendency to add your own, more expert views and let the students come to their own understanding of a case and its solution. Of course, this doesn't mean that instructors should avoid participating in the discussion. It means only that instructors should be constantly aware of the potential effects that their participation may have. Benefits of this strategy include:

Models expert responses. When the instructor models expert responses the students get a clearer picture of what is required of them. For example, in response to an ongoing discussion of the Michelle Nguyen case, one instructor wrote: "Playing devil's advocate, even if Michelle had conducted monthly (or quarterly) meetings with Alex and Susan, she still may not have found out soon enough about the library hours not being sufficient. I mean when is soon enough when you're creating CBI? And maybe the library hours aren't the real issue.... So the question I have is – do you think this case primarily illustrates a front-end analysis problem or an implementation problem? Ideas, anyone?" This comment was an example of both considering the implications of a recommendation that had been made (monthly meetings) and looking for the underlying principle (Do you think this case primarily illustrates a front-end analysis problem or an implementation problem?). Also, by prefacing the comment with the warning, "playing devil's advocate," the students realize that their previous comments are not being criticized. In this way, students are encouraged to think about the issues in ways they previously hadn't considered.

Supports ongoing dialog. The instructor's comments and questions can also encourage students to elaborate their thoughts about a point raised in the discussion. Other students can, then, respond to the elaboration, thereby continuing the dialog. For example, during the discussion of the Haley Lawrence case, we commented on one student's reaction by posing additional questions for students to explore. ["So what exactly do you think is motivating his actions? And how can Lawrence get through to him (and everyone else?)"] When instructors participate carefully, through questions and comments, students' problem-solving approaches may incorporate more expert-like characteristics, including the consideration of the impact of initial recommendations.

Limitations

We began this work with the idea of identifying patterns in the development of students' problem-solving skills. What we found, however, was an absence of patterns and, over the course of several semesters, our focus shifted to examining the coaching strategies we were using. In the previous section, we suggested several broad strategies instructors can use to guide their coaching. The strength of these suggestions, however, is limited by several factors, including: (1) our analysis codes and categories may not have been sophisticated enough to find patterns in students' problem solving skills, and (2) there may have been insufficient time for students' problem solving skills to develop. Both of these limitations provide opportunities for future research.

One of the unstated goals of this investigation was to develop and apply an analysis framework for examining students' responses to discipline-related case studies. The framework developed during this research, although greatly refined from its initial stages, must still be considered preliminary. Additional refinements are needed to allow consistent application while analyzing students' case responses.

The development of problem-solving expertise is known to take place over a long period of time. Trying to capture this development in a semester-long course is difficult, at best. Longitudinal studies are needed to determine if, and how, this process occurs over an extended period of time, and the extent to which instructors can influence that process through the coaching techniques they use during case discussions. Furthermore, it is important to determine the extent to which students who develop strong problem-solving skills within case-based courses actually transfer these skills to their future jobs. Does the experience of solving cases in a college course benefit instructional designers in their future practice? Further research is needed to address these important questions.

Conclusion

Case-based instruction has been heralded as a powerful means for helping instructional design students bridge the gap between novice and expert practice (Julian et al., 1999). However, case-based instruction does have its risks. Students may like using cases and perceive that they have learned a lot. But this does not necessarily mean that they have gained new or better problem-solving skills that will help them become better instructional designers. Blumenfeld, Soloway, Marx, Krajcik, Guzdial, and Palinscar (1991) suggested that "without adequate attention to ways of supporting students and teachers, learning-by-doing will not be done" (p. 374). Case-based instructors need effective strategies for supporting students during case study analysis. If not used well, cases may merely perpetuate the approaches and strategies that students already use. Clearly, teaching with cases is not an easy task. As noted by McNergney (1999): "Teaching and learning with cases is not for the faint of heart" (p. vi).

Sykes and Byrd (1992) stated that "learning from cases will depend on the interaction among what the case presents, what the reader brings, and what the teacher does with the case" (p. 511). J. Shulman (cited in Lundeberg, Levin, & Harrington, 1999, p. 15) expressed the importance of discussion and facilitation when she noted, "cases, even with commentaries, do not teach themselves." The role of the coach (instructor) is viewed as being critical to the success of the entire process. Yet, there are very few guidelines available for instructors who wish to begin using a case-based approach. With little guidance, instructors can easily fall into the trap of thinking that just because case discussions are interesting and engaging, that students are learning the things they need to learn to become better designers.

Through our ongoing examination of students' responses to the use of cases, we have identified techniques that appear effective in eliciting students' use of effective problem-solving strategies. Although our results are preliminary, this work addresses two important questions about the effective use of cases in instructional design courses including: 1) what to assess as evidence of students' learning in a case-based course and 2) how to achieve specific learning outcomes (e.g., increase in problem-solving skills) through the use of specific coaching strategies. To date, little work has been done to actually measure changes that occur in students' problem-solving skills through participation in a case-based course. Even less work has been done to tie specific coaching strategies to the attainment of those outcomes. This work represents the first step in addressing these important issues. Still, we realize that there is much more to learn. We plan to continue to examine specific coaching strategies that facilitate student problem-solving within case-based instruction. In addition, we plan to continue to hone our analysis skills so that we can more readily examine the effectiveness of different coaching strategies on the development of students' problem-solving skills. Ultimately, by refining our case-coaching strategies, we hope to increase the potential of case-based instruction to facilitate the development of expert problem-solving skills in our instructional design students.

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Appendix A: Descriptions of Coding Categories

1. Conceptualizing the issues (reporting vs. interpreting)

When confronted with a "messy" problem situation, novices are likely to report or summarize the issues, as they are described in the case. The report is often verbatim and appears to take the problem(s) presented in the case at face value with little apparent effort to consider the extent to which the presented problems are at the "heart" of the case. The result is a simple recounting of issues, as others see them, that often remains at a superficial level.

Experts are less likely to take the presented problem at face value. Instead, they will use their own experience to inform their view of the case and to reframe the problem, often using their own words. Experts are more likely to identify the "central" issue in a case or to categorize or prioritize the issues in some way, often including an explanation of the principle underlying the priorities. The result is an interpretation of the case that is often unique and specific to the situation.

2. Building on what is known (absent information vs. present information)

When confronted with an ill-defined problem, both novices and experts recognize that they have incomplete information. However, novices tend to focus on what they don't know and to ask questions designed to fill the perceived information gaps. In doing so, they seem to lose sight of what they do know, suggesting that a great deal of additional information is necessary before a solution can be developed. In addition, their approach to information gathering often seems scattered. That is, they suggest additional information without apparent consideration for the specific purpose or value of that additional information.

In contrast, experts more often focus on what they do know. They will make inferences based on available information and consider scenarios that are likely to emerge as more information is obtained. In addition, they tend to take a more focused approach to information gathering. That is, they will look for specific information that will help confirm or refute their interpretations or assess the effectiveness of their proposed solutions.

3. Attending to the relationships among factors (laundry list vs. coherent plan)

Both novice and expert problem solvers are likely to consider multiple factors in a case. However, novices often take a "laundry list" approach to both identifying problems and proposing solutions. With problems, this often takes the form of lists of issues (sometimes long lists) that are presented as separate items. There is little apparent consideration for how the issues might be related, perhaps as parts of a larger issue, and little apparent effort to organize the list. With solutions, this often takes the form of a list of suggestions, again presented as separate items with little apparent consideration for the relationships that might exist among the suggestions. In both cases, the result is a piecemeal collection of ideas that lacks apparent coherence or coordination.

In contrast, experts are more likely to have a coherent plan. They may identify multiple issues, but are more likely to make explicit links among those issues. Similarly, they may suggest multiple solutions, but link the suggestions together in a coordinated effort to solve the problem(s).

4. Considering solutions in tentative terms (dictatorial vs. advisory)

Both novice and expert problem solvers are solution oriented and often propose solutions early in the problem-solving process. However, they will do this in different ways. Novices often propose solutions in a dictatorial manner (you must ..., you should...). They are likely to take a judgmental position, often criticizing or finding fault with one or more key players in the case. In addition, once proposed, their suggestions are often "carved in stone." As new information becomes available, novices tend to stand by their original suggestions. Rather then modifying their suggestions, they often find ways to justify them in spite of the new information.

In contrast, experts recognize that the available information is incomplete and that there are multiple ways to address the different issues. As a result, they are likely to take an advisory tone when making suggestions (you might..., perhaps you could...). They are more likely to take an empathic position, explaining possible reasons behind the actions of the key players in the case. And they are more likely to modify or eliminate proposed solutions new information becomes available.

5. Considering the impact/implications of proposed solutions (narrow focus vs. broad focus)

Both novices and experts frequently suggest solutions to the problems identified in a case. Novices make suggestions without apparent regard for how those suggestions might be implemented or what effects they might have. That is, novices typically do not include overt consideration of impact and implications in their write-up of a case. When they do consider impact/implications, it is limited to

a narrow focus on resolving the identified problem. This takes the following form: The problem is ... What I would do is ... That would solve the problem by ...

In contrast, experts typically think through their suggestions, explicitly considering how those suggestions might be implemented and/or what effects they might have. In addition, their consideration of impact/implications is broader. It often goes beyond a straight-line focus on problem and its immediate solution to consider other issues that may be important (e.g., cost, time, reactions of key players).

THE VIRTUAL RETINA: IS GOOD EDUCATIONAL TECHNOLOGY ALWAYS STRATEGIC?

Sandra Dowie
University of Alberta

Educational technology units must continually monitor their strategic plans to ensure that they are aligned with the realities of their institutions. Strategic dissonance o ccurs when previously successful strategies are no longer achieving the same positive outcomes. The Virtual Retina project is used here as an example of strategic dissonance for the Academic Technologies Centre (ATL) at the University of Alberta. In addition, a number of methods for analyzing the strategies used by educational technology units are presented. These methods provide a means for units in higher education to conduct the ongoing task of maintaining their strategic plans.

The Academic Technologies for Learning Centre (ATL) is the campus educational technology unit at the University of Alberta. For over five years, it has effectively facilitated the professional development of instructors and supported the production of educational resources. The e ducational technology environment is a "high velocity" world with rapidly shifting demands and expectations. This necessitates that units such as ATL continually monitor the effectiveness of their strategic plans to ensure that they are aligned with the realities of the academic environment. During this monitoring process, it is important to be attuned to situations in which previously effective strategies aren't achieving the expected positive outcomes.

ATL's products and services, effective until recently, are no longer achieving the same positive outcomes. This sort of change would be expected in the dynamic field of educational technology,

> *...in extremely dynamic industries alignment between a firm's strategic intent and strategic action is not likely to last. Inevitably, strategic actions will begin to lead or lag strategic intent. Such divergences between intent and action cause 'strategic dissonance' in the organization.*
>
> (Burgelman & Grove, 1996, p 8)

Strategic dissonance can be used as a lever for improvement within an organization if it results in a thorough analysis of the organizations external environment and internal capabilities. This sort of analysis is often referred to as a strategic analysis. There are many methods for conducting a strategic analysis that will enable an organization to improve its approaches rather than experience ongoing failure.

The Virtual Retina CD-ROM project is presented here as an example of strategic dissonance, the Achilles heel of many educational technology units. Following this case, a number of methods for analyzing the strategies used by educational technology units are presented. These methods provide a means for units in higher education to conduct the ongoing task of maintaining their strategic plans.

The Virtual Retina: A high-tech case study

ATL employs twenty staff members whose range of expertise includes instructional design, evaluation, multimedia development, Web authoring, and graphic arts. ATL provides grants for ATL partnerships to instructors as the U of A. The grant includes money intended to support release time for instructors to work in the ATL production studio learning instructional design and technical production skills. ATL also offers a diverse range of workshops related to teaching and technology to the campus.

The Virtual Retina CD-ROM was created through an ATL partnership grant provided to the Department of Ophthalmology at the U of A. The project team consisted of three ophthalmologists, a medical student, an instructional designer, an Authorware developer, and a graphic artist. For the Virtual Retina partnership, the grant was used to employ the medical student to work full time in the ATL production studio for six months. The project lasted from December 1999 to August 2000.

The CD-ROM contains a virtual clinical environment to provide residents with skills and experience related to diagnosis of diabetic retinopathy, a leading cause of blindness in developed countries. As some diabetic pathologies are clinically diagnosed by their 3D appearance, problem-based cases require learners to evaluate 3D digital photographs. Through this application, learners

acquire a thorough understanding that would otherwise take an extended period of time to achieve through traditional clinical observation. The Virtual Retina CD-ROM contains the following features:

Case-based problem solving: In the CD-ROM's Clinic, learners practice diagnosing and prescribing treatments for a comprehensive set of pathologies without being dependent on the availability of patients.
3D digital imagery: Digital imagery has been used in ophthalmology for some time now, but never in 3D. The observation of the stereographic appearance of several diabetic retinopathic lesions is vital to diagnosing and managing patients. A partnership with Stereoviewer Inc. has enabled the incorporation of this advanced technology.
Interactive tutorials: Highly visual tutorials accompanied by decision trees provide vital background knowledge about diabetic retinopathy and illustrate the diagnostic decision making process.
Library of articles: Learners can acquire copies of comprehensive literature reviews on pertinent topics in diabetic retinopathy.
Glossary: Key terms are defined and hyper linked throughout the application.

The Virtual Retina CD-ROM will be used by approximately five ophthalmology residents a year at the U of A. It will also be available at no cost to Canadian ophthalmology schools of which there are nine English-speaking and two French-speaking programs. The Virtual Retina application is sound pedagogically and has superior production values.

Despite the obvious merits of the Virtual Retina CD-ROM, the project has been the topic of much debate at ATL. One concern is that the project consumed a significant amount of resources, yet will only be used by a handful of medical residents a year. How does an educational technology unit evaluate whether to develop resources that will be used by five ophthalmology residents a year versus resources that might support 400 first year students? Does the Ophthalmology department, through the sponsorship of charitable foundations such as Canadian National Institute for the Blind and the Canadian Diabetes Foundation, better fund a project such as the Virtual Retina?

Secondly, while the ophthalmology instructors were the primary partners for this project, they had little time to devote to contributing content or being involved in the ongoing development effort. Thus, the U of A faculty members did not develop any new skills and understanding related to teaching and technology, which is the intended outcome of the ATL partnership program. The medical student acquired many skills related to multimedia development including multimedia script writing and project management. However, he is not part of the university teaching staff, so ATL's primary function of being a professional development rather than production unit was not realized with this project. This is an excellent example of strategic dissonance...the intent of the ATL partnership was only partially realized despite extensive support and a high-quality product as an outcome. This situation was experienced in other projects at ATL over the course of the past year.

Are CD-ROM projects inherently too costly to be sustained by campus-based technology centres? Or, should more of this high-end type of production be supported? How do organizations such as ATL and other campus educational technology centres formulate the strategies they will use on an ongoing basis? While people are generally aware of how to compose mission and vision statements, the path to a clear set of operational strategies is one full of dead-ends and morasses of detail.

Using strategic analysis strategies

While ATL's business plan is full of noble goals, a precise set of operational strategies is lost within the exhaustive lists of tasks. Strategic planning involves assessing both the external competitive environment as well as the internal capabilities of an organization to meet the demands of the campus environment. In the following, a sampling of methods will be used to assess the internal resources and competitive capabilities of ATL. These methods include strategic mapping, SWOT analysis, value chain analysis, and competitive strength assessment.

Descriptions of methods for conducting strategic analysis are usually framed for business and industry environment and are fraught with terms such as "rival", "marketplace", and "threats." These terms are not commonly used within academia. However, perhaps they should be. Often campus units, such as ATL, flounder as they apply imprecise planning models. A more "business-like" approach to strategic analysis can yield many valuable insights and is appropriate for the public sector in general and universities in specific (Poister & Streib, 1999; Tischler, Biberman, & Alkhafaji,1998).

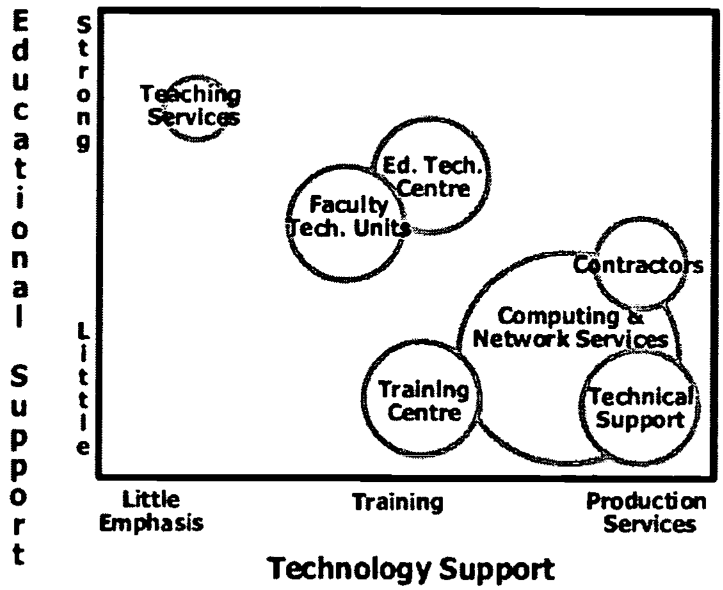
Several questions will be used to structure the discussion. The answers to these questions provide a number of vantage points from which to view ATL's strategies (Thompson-Strickland, 2000). This process is one valuable not only for ATL, but also for other educational technology units coping with the ever shifting dynamics of educational technology implementation on their respective campuses.

What is the unit's external competitive environment?

ATL is located on a campus that serves approximately 30,000 students. It has a faculty of tenured and part-time teaching staff approaching 3,000. A number of other centres on campus serve this population of instructors. Some provide services that overlap ATL's. To remain viable, ATL must demonstrate that it is filling an important niche on campus. It must continue to differentiate its services in a way that satisfies University Hall's desire to avoid redundancy and support only those organizations adding true value to the university.

Strategic maps are one way to visualize the relationship of an organization to other "competitors." While units situated on campuses are sheltered from the full force of a free market, they are funded by central administration and vie for the limited funds available. In this sense, an educational technology unit's competitive market consists of the centres that support teaching and technology use on campus. A strategic map such as shown in Figure 1 depicts how campus-based units position themselves related to supporting academic staff members at the U of A.

Figure 1: Strategic Map of a Campus Educational Technology Centre



In the above map, technology and educational support have been chosen as the two axes. However, any two variables that distinguish the activities of organizations can be used. A circle roughly proportionate to the size of its operating budget represents each entity.

The map demonstrates a clustering of centres in the lower right quadrant. These centres are largely technology focused with little emphasis on effective teaching. In the map, it is evident that ATL serves an important niche by providing services related to both instruction and the application of technology and is currently favorably located on the map. The proximity of the faculty-based units to ATL illustrates their direct competition with ATL. A number of questions that arise with respect to ATL and campus technology units in general in connection to the strategic map. What services do the units offer that overlap with other organizations? How might ATL operate to capitalize on its niche and maintain or expand funding? How might ATL position itself in relationship to faculty-based units to avoid losing funding as more and more of these centres develop on campus? Some of the answers to these questions may be achieved from an internal analysis of ATL guided by the following five key questions.

How well is the present strategy working?

The competitive approach ATL uses is to provide a differentiated range of services that are not available elsewhere on campus. Clear standards to evaluate ATL's success are absent from ATL's strategic plan. However, several means that might be used for this type of evaluation are suggested below.

Table 1: Success Indicators for ATL

Success Indicators	Evaluation of level of success
Proportion of target population served	On a recent survey, respondents indicated that 22% had accessed ATL's services while 40% had accessed the campus teaching centre's services.
Cost effectiveness compared to other centres, both on campus and off	Smaller faculty-based centres may also be viewed as more cost-effective.
Partners' evaluations of services	Research is underway on this issue
Number of new media resources created	This isn't tracke d effectively. Projects often take a long time to complete and there are some, which do not result in the development of resources.
Utilization of ATL's production studio	Below capacity.
Impact on teaching and learning on campus	This is tough one! But, ultimately an indicator critical to ATL's long-term competitive success.

Given that indicators such as profit margins are not relevant to ATL, one strategy for this centre is to benchmark its key activities against other educational technology centres both on and off campus. To keep its competitive advantage on campus, ATL must become proactive in determining standards for measuring its success and in developing strategies to achieve these standards.

What are the organization's resource strengths and weaknesses and its external opportunities and threats?

A SWOT analysis is a review of an organization's resource strengths and weaknesses contrasted with its external opportunities and threats. This analysis enables planners to aim to produce a good fit between an organizations capability and the demands of its market situation. ATL's SWOT analysis appears in Table 2.

Table 2: SWOT Analysis for ATL

Potential Resource Strengths & Competitive Capabilities	**Potential Resource Weaknesses and Competitive Deficiencies**
• expertise in instructional development and evaluation • technical expertise in new media • well-endowed technical facility • direct contact with VP Academic • recognized campus leader in instructional technology development	• under-utilized facility capacity • R & D not adequately supported by skilled staff • greater emphasis on excellence in research rather than on superior teaching on campus
Potential Opportunities for ATL	**Potential External Threats**
• faculty-based units don't have resources for R & D • increasing impetus for higher education to review curriculum • distance education programs expanding • ever increasing need for production support	• possible pressure to become a cost-recovery centre • shift to early-majority adopters changes typical client needs • faculty-based centres might duplicate services and request central funding • proliferation of workshops related to technology

For ATL to sustain is position on campus, it must capitalize on internal resources that are ...*valuable, rare, and costly-to-imitate*... (Barney, 1995). The combined skills of instructional development and educational technology meet these criteria as they are rarely found on campus and are hard to duplicate. These competencies are further augmented by ATL's financial capability to support research and development in the field of instructional technology. These competencies are what ATL does best and will insulate it from many of its external threats. Market opportunities to heed are the

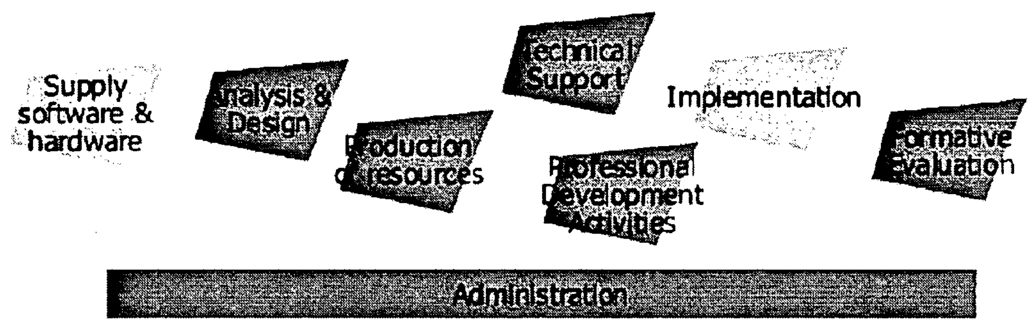
needs of faculty-based units for support, the ever-increasing impetus on campus for new media production support, and the expanding number of distance education programs.

Are the educational technology unit's prices and costs competitive?

One of ATL's most powerful clients is University Hall as it funds ATL. Therefore, it is essential that ATL demonstrate a solid return on investment for this funding. Faculty members are also clients. As most of ATL's services are available at no cost, a critical cost for faculty members is time spent on projects. ATL must manage its projects in a time efficient manner to satisfy these clients.

A value chain analysis reveals the core activities used to design, produce, market, deliver, and support a product or service. ATL's value chain is shown below. The lighter boxes indicate services that ATL does not provide.

Figure 2: ATL's Supply Chain



While value chains typically show a flow between one activity and the next, an important characteristic of ATL's value chain is that the activities are not necessarily integrated or sequential. Clients often access ATL at various segments of its value chain. For example, ATL staff members are frequently asked to provide technical assistance to faculty members who haven't been involved in any way with ATL previously. While random access to workshops may be supported, random access across the value chain leads to a fragmented, costly approach. Staff work with bits of projects out of context and aren't able to assure a high-quality outcome. As well, staff members are continually disrupted in their work and are unable to complete high priority projects. ATL has not been positioned as a help-desk service provider, yet much time is devoted to this sort of response to the detriment of other activities. On a strategic level, ATL's value chain should be integrated and streamlined to avoid falling into the *something for everyone* trap.

Porter (1996) stresses the importance of making trade-offs and integrating activities to assure that an organization achieves and maintains its competitive advantage.

> *There will be constant pressures to compromise, relax trade-offs, and emulate rivals. One of the leader's jobs is to teach others in the organization about strategy—and to say no.*
> (Porter, p 77)

Tradeoffs are prerequisite to strategic planning because of problems due to:

- inconsistencies in image and reputation
- different activities require different product configurations, different employee behavior, different skills, and different management systems
- limits due to internal coordination and control

For ATL, making trade-offs might mean providing technical support to only those clients that are involved with ATL on a complete project. Activities would also be aligned to focus on activities that are of a high value to ATL strategically. For example, other campus centres provide technical help-desk support or technical training workshops. ATL should divest itself of these activities and focus on activities related to maximizing the number and quality of instructional technology projects it supports. This sort of approach involves a number of difficult decisions for ATL. Its management will be well advised to consider Porter,

> *...a strategic position is not sustainable unless there are trade-offs with other positions.*
> (Ibid, p 68)

In all of this, operational effectiveness must be assured (Porter, Strickland-Thompson, 2000). Activities in ATL's value chain are often highly time-consuming for ATL staff members and their

clients. Streamlining the analysis, design, and production process will be essential to effective operations. Project management is gradually evolving at ATL. It is a difficult process as many aspects of the university environment are at odds with a more business like production process.

How strong is the centre's competitive position?

In a business environment, the success factors are used to evaluate a business's competitive advantage. In an academic environment, analyzing the success factors indicates the strengths and attributes of ATL in comparison to other centres on campus that also address teaching and/or educational technology. A preliminary outline of factors essential to ATL's success is listed below.

Table 3: Key Success factors for ATL

Factors
Instructional design expertise
Evaluation expertise
Technological expertise
Good communications & teaching skills
Reputation on campus
New product innovation capability
Project management skills
Academic research capability
Cost position relative to other campus centres
Production resources (hardware, software)
Customer service orientation

These success factors were circulated to ATL's management and staff who were asked to rank the importance of each factor. For several of the factors, staff responses diverged significantly from the director's. This suggests that more discussion needs to take place within ATL regarding its direction.

ATL should undertake to define its Key Factors for Success and reach understanding within the organization about the relative importance of each factor. Then ATL can use this inventory of factors to compare ATL's capabilities to other campus centres. For example, if ATL's production services are judged to be below par, while other centres are comparatively superior, ATL has at least two choices. It may choose to outsource the production aspects of projects to other units, or it could devote resources to increasing its capability in this area. Choices such as these impact whether or not ATL undertakes projects such as the Virtual Retina CD-ROM in the future.

What strategic issues do educational technology units face?

A number of experiences such as the Virtual Retina project have compelled ATL to ask sharp questions about the effectiveness of the various services it offers. As a result ATL has come to realize that many of its strategies have been tailored to address the needs of educational technology's "early adopters" at the U of A (Rogers, 1995). ATL's focused differentiation of products and services for this group is increasingly out of alignment with the characteristics and needs of the growing population of instructors using technology who may be categorized as being part of the "early majority." The characteristics of this model are summarized below and contrasted with an alternative model that is more attuned to the early majority of educational technology users on campus

Table 4: The Shifting Needs of Clients

	Early Adopter Model	**Early Majority Model**
Client	instructor	department
Instructional design	idiosyncratic	team effort
Process	residency at ATL	project meetings
Production	instructor (or assistant)	project team
Outcome	resources for single course	resources for several sections or program
Time available	extensive	moderate
Risk at evaluation time for instructor	high	low

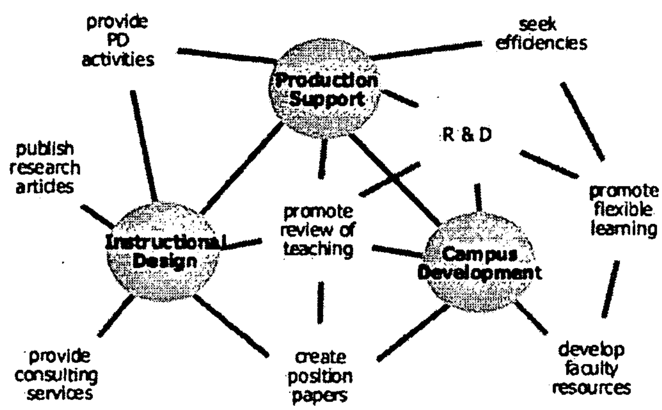
In reconsidering its strategies, ATL must avoid trying to straddle between two programs. This would occur if ATL attempts to combine significantly different approaches to professional development with existing programs and services. This approach is doomed to failure. Tradeoffs have to be made and accepted (Porter). The Virtual Retina project demonstrated something that as occurred on a number of ATL projects. The production model that required faculty members to learn then produce their own instructional resources is no longer a viable mode for faculty development. The early adopters' zeal for committing to long term, hands-on production is not matched by mainstream faculty members. Different strategies are needed for both production and faculty development.

In past strategic planning efforts, it seems that ATL management and staff have been swamped by the number and complexity of ATL's initiatives and have difficulty seeing the larger strategic structure of ATL's activities. The analysis methods described to this point enable people within an organization to develop an number of perspectives on both their external competitive environment and their internal capabilities to respond to this environment. Vanguard's Activity System Map is a good next step for ATL as it moves towards refining its existing strategic plan. This map represents the network of activities conducted by an organization. These types of maps...

> ...show how a company's strategic position is contained in a set of tailored activities designed to deliver it. (Porter, p 71)

A suggested Activity System Map for ATL is shown in Figure 3.

Figure 3: ATL's Activity System Map



After completing the Activity System Map a technology unit's management should ask the following sorts of questions:

- Are the activities consistent with the unit's overall positioning? (i.e. needs served, type of clients accessed)
- How do the activities within the unit reinforce or detract from each other?
- Could changes in how one activity is performed enable others to be phased out?
- What broad strategies and goals for the unit can be used to direct these activities?
- What are indicators for evaluating the success for each of these activities?

With an Activity Map the salient features of an organization become apparent. Broader strategies emerge and are readily translated into a concise strategic plan for the organization. At this point, educational technology units are ready to assess whether projects such as the Virtual Retina CD-ROM are aligned with the strategic plan.

Conclusion

Only a sampling of possible methods for analyzing an organization's external competitive environment and internal capabilities have been explored. There is a wealth of resources designed for business and industry that can be used to free up blocked strategic planning. Project's such as the Virtual Retina inform an organization that it is entering a period of strategic dissonance, a time when successful strategies no longer work on all dimensions. At such times, strategic analysis methods

facilitate the asking and answering of fundamental questions related to direction, purpose, and relevance of core strategies used by an organization.

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To find out more about the Virtual Retina application, please visit: www.virtualretina.com

Privacy And Anonymity: Issues For Online Students Or Not?

Sandra L. Novick
Dannie B. Francis
University of Wyoming

Abstract

With the advent of the Internet, email and increased use of online services issues of privacy, anonymity and security of personal information have evolved to a new level of importance. These issues have been discussed extensively as related to open access online services but are yet to be fully addressed for students of online classes. This pilot study sought to determine if students of a web-based distance education course had expectations of privacy, anonymity or issues of sharing personal information as related to the web mediated interactions of the online course. Students taking their first online course were found to have significantly higher concerns related to privacy issues than those who had previously taken online classes. With the increase in web-based distance education courses and entire degree programs being offered through the Internet it is important to determine student attitudes which might effect success of such programs and students.

Introduction

With the advent of the Internet, email and increased use of online services for web-based instruction, web enhanced or supported instruction (such as chat rooms, streaming video, and threaded discussions) issues of privacy, anonymity and security of personal information have evolved to a new level of importance. There has been a great deal of discussion and several studies (Bodi, 1998; Descy, 1997; Metivier-Carreiro & LaFollette, 1997; Singleton, 1998) conducted concerning privacy and anonymity of persons who use the Internet. For adult educators Holt (1998) reminds us, these concerns are not unique to the Internet, but "risks may be magnified by the power and reach of electronic systems" and are yet to be addressed for students of online classes.

Distance education and more specifically online courses bring into play a new set of *classroom* variables and factors (Holt, Kleiber, Swenson, Rees and Milton, 1998). Of interest here are the changing attitudes and expectations of distance education students who now are partaking of education through the electronic forum of the Internet. For example, within the traditional classroom a student's appearance, and usually both gender and race, are apparent to fellow classmates. The face-to-face interaction often found in traditional educational settings usually results in students revealing components of their personalities, whether it is a tendency to be out spoken or a lack of participation that might be interpreted as shyness, or some other trait, often there is some insight into the person behind the student. This face-to-face interaction is missing in the online environment of a web-based distance education course.

Because of this environmental difference between traditional and online education we sought to determine if students of a web-based distance education course had expectations of privacy, anonymity or issues of sharing personal information as related to the web mediated interactions of the online course. For the purposes of this study privacy was defined as the release of personal information to other members of the online class, including name, home address, phone number, and posting of their picture while anonymity was considered to be the ability to conceal one's identity and true personality, even use of an alias.

While it has been shown that individuals utilizing web-based commerce and social interactions, email and chat rooms have expectations of privacy, anonymity and personal information sharing subject to the implied security level of each activity and educators note that such issues should be of concern for online students (Holt, 1998) the literature does not contain specific research reflecting the attitudes of students in web-based distance educational environments towards these areas of personal concern.

Methods

Students in an online distance education course offered by the Adult Learning and Technology Department of the College of Education at the University of Wyoming were approach via the announcements area of one of the course modules to volunteer to complete an online survey regarding attitudes towards issues of privacy, anonymity and personal information sharing in an online educational environment. The survey was given during the next to last week of the course, which was on distance education technology. The survey was built in Macromedia's Dreamweaver 3 software using radio buttons as the response method. The URL for the survey was given and students who chose to participate were asked to select the URL and complete a questionnaire consisting of a multiple choice demographics section plus 17 attitudes questions. The attitudes questions used a Likert scale of 5 categories from strongly agree to strongly disagree. Respondents submitted the completed questionnaires via the Internet by choosing a submit button. Likert responses were weighted 1 through 5. Responses to questions were tallied with a strong concern for privacy and/or anonymity resulting in a low score (1) while a strong preference for openness or no privacy or anonymity resulted in a high score (5). Of the 17 questions 9 were related to issues of privacy and 8 to issues of anonymity. Statistics were performed using SPSS.

Results

Of the 29 students in the course 12 (41.4%) responded to the online survey, which is typical of online survey response rates. Of the respondents 58.3% (7) were female and 83.3% (10) were 41 years or older. A majority of the students were married (75%) with no children still living at home (83.3%). There was a fifty-fifty split between full time and part time student status and 58.3% were employed full time. Eight respondents had never taken a web-based distance education course (66.7%). Only 16.7% (2) of the responders had not taken traditional classroom style courses at the post-secondary level. The majority of responders were enrolled in a degree-seeking program (66.7%) at the graduate (50%) or undergraduate level (16.7%). The reasons most often cited for taking this online course were the flexibility of time (16.7%), inability to travel to the campus (25%), and that this course was only being offered as an online course at this time (33.3%). None of the respondents reported a preference for a web-based environment as their reason.

Weighted privacy and anonymity values were determined based on responses and number of questions pertaining to that category in the instrument. The scores were analyzed using independent t-test. Students who had not previously taken an online class were found to have a significantly lower mean score on privacy (showing more concern) than students who had taken 2 or more online classes ($t = 2.47$, $p = .032$).

A principal component analysis extraction of the data showed a high degree of covariance, with all questions highly related as shown by the consistency of responses. The strongest reactions came to questions such as, "Should a student be able to use a pseudonym (as opposed to their real name), for chats and threaded discussions"? Ten of the twelve respondents either disagreed or strongly disagreed (83.3%) with the concept that students should be able to act anonymously. Of interest because of the relative neutrality of responses are mean results for some of the individual questions (5 = strongly agree, 3 = neutral, and 1 = strongly disagree); security of information that is shared in an online class (2.75), live video and audio for chats (3.5), sharing biographies at the beginning of the class (3.66) and students should post their picture as part of the introduction process (3.0). Mild concern was expressed over sharing personal data such as home phone numbers or addresses (2.08).

Conclusion

While the sample number (n=12) is low this pilot study shows that students who had not previously taken an online course had greater concerns of privacy than students who had prior online coursework. We know that users of chat rooms and e-commerce expect a certain level of security (Moss, 2000) it appears from this limited study that perhaps first time students of online distance education classes have similar concerns while "experienced online students do not. Perhaps this is in part due to the fact that experienced students realize they are entering a somewhat more secure or closed environment in the form of an online course.

Refinement of the questionnaire, increase in the number surveyed and performing the survey again on both first time students and experience online students would be needed to confirm the findings of a difference in attitudes related to issues of privacy in these two groups of students. With the increase in web-based distance education courses and entire degree programs being offered through

the Internet it is important to determine student attitude s which might effect success of such programs and students.

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Redesigning The Distance Education Courses of Anadolu University in Turkey

Cengiz Hakan Aydin
Anadolu University

Abstract

Developments in communication technologies and instructional methods force distance education providers to change the way they try to help learners. Anadolu University as one of the biggest distance education providers in Turkey has been trying to adapt its distance education programs to this new situation occurred especially during 1990s. The University has developed a new distance education model and lunched a project to help the learners. This model includes use of textbooks, television programs, computer-based instruction programs on CD-ROMs and Web sites either together or alone depends on the learners ability to access the equipments necessary for the materials. This paper aimed to explain details of this ongoing project in Anadolu University.

Introduction

Distance education, the structured teaching-learning process that is not limited by time and place, is one of the fastest growing applications of educational technology. This growth has occurred especially in the last decades of 20th Century. During this period, developments in computer based delivery systems and in instructional strategies have caused significant changes in the field of distance education. Distance learners have had better opportunities and freedom to determine when, where, what, and how to study since the distance education providers started to adapt their services according to these changes.

As one of the largest* distance education providers, Anadolu University could not stay unaware of these changes in the field. Therefore, the University has launched a new project in 1999 about redesigning the distance learning courses in the light of past experiences and principles of instructional design.

This paper aimed to explain details of this ongoing project in Anadolu University. It is hoped that the explanations here will help readers to comprehend how a highly content-focused distance education system is trying to transform to a learner-centered system.

First, this paper will summarize some of the trends influencing the field of distance education. Next, it will give some of the current statistics about the Open Education Faculty of Anadolu University. Finally, the paper will clarify the details of the project and explain what has been done since the beginning of the project.

Some of the Trends in Distance Education

Distance education has been influenced by the developments in many other fields since its pioneers. It is not the intent of this paper to explain all these fields and the developments. However there are two of them that have had major effects on recent implementations of distance education.

One of these is the field of communication technologies. Since distance learners and the instructor are separated, there is a need for an artificial communication medium that will provide a channel for information flow and interaction between them.

Distance education providers have successfully been using different forms of communication technologies for meeting this need. Print form was the first and the widely used one, but, as Spodik (1999) points out, audio and video broadcasting technologies helped to revolutionize the scope and capability of distance learning programs. However all these have brought tremendous financial cost and many restrictions on the learners.

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* In 1998, the World Bank recognized Anadolu as the world's largest university (Potashnik & Capper, 1998).

On the other hand, for many (Harrasim, 1990; McIsaac & Gunawardena, 1996; Schrum, 1999) recent developments in computer based communication technologi es opened new doors to distance education providers due to their unique characteristics such as speed of delivery and increased interaction. The practices have shown that computer based communication technologies helped the distance education providers to reach more geographically and physically separated individuals, to offer more interactivity among the learners, to incorporate new instructional methods, and above all to bring the distinctions between distance education and traditional education closer (McIsaac & Gunawardena, 1996).

Developments in the field of instructional psychology have also been influencing the distance education practices to a greater extent. Recent studies on learning have revealed that learning is a change in meaning constructed from experience (Newby, Stepich, Lehman & Russell, 1996), and after bringing his/her prior knowledge to the learning experience, the learner co-construct new meaning onto former knowledge through interaction with the material, with the other learners and with the instructor (Morphew, 2000). That is why this new approach has been called as constructivism, or constructivist learning. In general, a constructivist learning activity is more learner-focused and includes a set of tasks and resources available to learners for actively creating their own meaning in an authentic context rather than passively absorbing knowledge structures created by the instructor.

Tam (2000) indicates that when applied to the distance learning context, there is no doubt that constructivism and the use of new technologies will help transform significantly the way distance education should be conducted.

> "... computer-mediated communications, computer-supported collaborative work, problem-based learning environments, and computer-based cognitive tools, for example, can offer the field of distance education alternative approaches to facilitate learning. These constructivist environments and tools can replace the deterministic teacher-controlled [content-focused] model of distance education with contextualized work environments, thinking tools, and conversation media that support the knowledge construction process in different settings."

Especially during late 1990s, observable consequences and products of this approach have started to be seen in the distance education programs. For instance, Jonassen, Peck and Wilson's (1999) conceptual model of learning environments for technology gives details and examples about creating constructivist distance learning environments..

Distance Education in Anadolu University

According to Daniel (1996) Anadolu University is one of the mega universities* of the world because of its nearly 600.000 enrolled students.

The University was created in 1981 from an older institution, the Academy of Economics and Commercial Sciences of Eskisehir. In 1982, a school, named Open Education Faculty was founded in order to supply the demand of higher education.

By the 1982-1983 academic year, Open Education Faculty had enrolled 29,479 students in the fields of economics and business administration. By the 1999-2000 academic year, the number of the new enrolled students reached 182,000 in four 4 years programs (economics, business administration, preschool teacher education, English teacher education) and 166,000 in 22 other 2 years programs (e.g. export, banking and insurance, public relations, book keeping, tourism, hotel management, sale management), two if which are designed for the Turkish citizens living in different cities of Europe.

The Open Education Faculty is legally required to accept any applicant who scores at least 105 on national entrance exam (average score is around 160). There is an idea about taking anyone who wants to get in any program of the Faculty, but has not been applied yet.

The Open Education Faculty uses mostly printed texts and television programs as the course materials. All these materials are produced in-house. The Faculty has printing facilities and professional TV studios for the production of distance learning materials. More than 400 textbooks have been printed and 2.200 TV programs have been produced since the foundation. The Faculty broadcast nationwide six hours of programming everyday on Channel 4 of the Turkish Radio and Television Corporation.

* Mega-universities are large open universities, each of which enrolls more than 100,000 students per year.

In addition, there are 81 administrative centers throughout the country and in 58 of them students can attend noncompulsory evening classes several times per week to get the academic counseling.

The Faculty tries to bring new technologies into the system. For instance, a pilot marketing course was delivered through videoconferencing at a school in Kazakhstan. Also, in computer based instruction department, several samples for different courses are produced each year. However the system heavily relies on textbooks.

One of the main problems of the Open Education Faculty is the low graduation rate. According to most recent statistics, only 34% of those who enter the two years program earn degrees within two years, and just 23% of those who begin four-years programs in four years.

Studies have shown that 76% of the students holds part and full time jobs and having difficulty for leaving time for study. It is also determined that most of the students are not using the textbooks designed and written by the Faculty of Open Education. Instead the students find the books that are published by the private companies easer to read and understand, and also more helpful for themselves. It has been noticed that the main goal of these books is to prepare students to the exams instead of instruct. Thus, they include few explanations about the content but lots of practice.

The students list the problems about the Faculty of Open Education's textbooks as being very complicated, including long texts, having academic language, requiring lots of time to study, and providing few practice. The students indicated that because of these reasons they think the books are hard to read and understand.

The Project

The low graduation rates, critics about the delivery systems, and trends in distance education have forced the Open Education Faculty to redesign its courses. Therefore, the Faculty has launched a new project in 1999 about redesigning the distance learning courses in the light of past experiences and principles of instructional design.

The project consists of four stages: Firstly, most of the Open Education Faculty programs started in different years so that each curriculum developed separately. As a result of this many courses that included almost the same content were offered and materials for these courses were produced. This was nothing but only vast of time, money and effort. Thus, in the first stage of the project, it was planned to re-develop the curriculum of each program and determined to give the priority to the four years programs (especially economics and business management). These courses re-developed and standardization secured among the programs. During this stage, content specialists worked with instructional designers to determine the main goal and objectives of each courses in the programs.

Secondly, as a result of critics about the current materials, the administration of the Open Education Faculty wanted to provide more appealing, effective, and efficient materials to the students. After several analyses, it has been decided to use multiple media formats for each course because of a constructivist idea that advices proving multiple representations of the knowledge to the learners for helping them in constructing their knowledge. A textbook with an accompanying computer-based instruction program on CD-ROM, a television program, and a web site were the media selected for the courses.

According to this selection, each medium is responsible for the different aspects of instruction process. In other words, textbook is the main source for providing information to the learners while television program shows the real life examples related to the information supplied through the textbook. Computer-based instruction program on CD-ROM is designed to overcome the lack of interactivity between the learner and the material. The Web site, on the other hand, that allow both synchronous and asynchronous communications not only among learners but also between learners and instructor is intended for the solution of other interactivity problems (learner to learner and learner to instructor). The main idea behind these sorts of uses of media is to help the learners to get advantages of different media attributes (Kozma, 1994).

However, it has been found out that most of the distance learners in Turkey do not have an opportunity to access a computer and/or Internet. According to recent figures only 8% of the Open Education Faculty students have access to computers although the Faculty has established 14 computer facility centers throughout the country since the early 1990s.

Also, some of the learners, especially who live in rural areas of Turkey, are not able to watch the television programs for varying reasons.

In order to overcome these problems, the all materials (textbooks, computer-based instruction programs, television programs and Web sites) are designed in a manner that each of them can provide all aspects of instruction process (e.g. motivating learners, providing information, giving practice and feedback, etc.). For instance, Web site has several links that takes learners to sites where they can get information about the topic, have opportunity to practice and get immediate and/or delayed feedback, and so on.

After selecting and designing the instructional media, thirdly, a pilot project is planned to be done in order to see effectiveness and appeal of materials produced according to instructional design principles. An instructional design team including an instructional designer, a graphic artist and a content specialist was formed in summer 1999. The main duties of this team were determined as preparing a model chapter and conducting a pilot test to see if the new approach (designing instructional materials according to the instructional design principles and theories) has positive effects on Open Education students.

The team, first, selected "law of demand and supply" as the topic of model chapter because the students studying in different Open Education programs found it as one of the most important and difficult topics. Then, the team prepared a model textbook chapter according to instructional design, visual communication, distance learning and adult learning principles. As a result of this, many new features such as advance organizers, attention-focusing devices, follow up activities, embedded tests, new graphical look are used in the chapter. Then a TV program specialist and a computer based instruction expert joined the team. They also worked collaboratively with the other members of the team.

After preparing all the materials, the team called the Open Education students in Eskisehir (a town where the University is located) to participate the pilot test. During the test, 15 voluntary participants are asked to study the chapter at home or work and take notes about the strengths, limitations, and time spend to study. Unfortunately the participants could not reach the tv program and the web-based instruction materials due to technical problems and the traditional belief of seeing the textbook main means of instruction. However they had chance to review the printed material. After completing, the students are asked join a face-to-face conversation about the materials and asked to mention again their ideas about the model chapter. Also, a test consist of items related to the topic covered in the chapter administered to the participants to see how well the model helped them to learn the content.

The participants' high scores and their positive remarks on the model chapter satisfied the team and the administration of the Faculty. All the participants got very high scores at the test administered right after they completed studying the materials. Some of the participants took the scheduled mid-term exams after the study and they verbally expressed that they did not have any problem answering the questions about the "Law of Demand and Supply".

All the participants also liked the idea of using an advance organizer, which was a short beginning of an article taken from a daily newspaper. The participants also found the recaps and the embedded test very beneficial; follow up activities and web addresses very useful. On the other hand, they thought that the warm-up questions at the beginning were quite difficult and were not interesting.

In addition, during the personal conversations the participants mentioned that the well-designed tv and computer based instruction programs might be very useful for the ones who have access to these programs.

Later, fourthly, the Faculty administration decided to use new materials during the 2001-2002 academic year. So that, course materials design teams were formed for each course and they started to work on the course materials on the bases of the model chapter on "Law of Demand and Supply", which was revised in the light of the participants suggestions, under the supervision and coordination of the instructional design department.

The core team usually consists of an instructional designer, a content specialist, a graphic artist and a coordinator. Besides tv program specialists and web/computer based instruction experts are joining the team.

According to the plans, these teams firstly focus on the textbook because it is a fact that textbooks are the ones almost all students easily reach. They start training writers about the new structure of the course materials and instructional design principles (advance organizers, instructional objectives, etc). After receiving the written chapter, the team members meet with graphic artists, and tv and web/computer based instruction specialists. While graphic artists add visuals into the text the tv program s, web pages and computer based instruction specialist starts producing the programs. The core team members secure the interrelations among all these materials. After completing all the materials,

they are revised by the course team. The team offer revisions if there is a need. After revisions and duplicating, all the materials are packed together as the course materials.

But, due to lack of enough time and qualified human resources, production of web/computer based instruction programs were postponed. So the project has continued with the production of textbooks and tv programs.

There have been some other obstacles in the design and development procedure, too. One of the very important one is the limitation of the number of the instructional designers in Turkey, especially in Anadolu University. This number is limited only to the fingers of a hand. Due to this limitation, each instructional designer had to be in different course teams. This caused the problem of not focusing on the each course intensively. However, during the project several new graduates of the Educational Communications and Planning Department o Anadolu University helped these instructional designers and through this participation they got training about the instructional design and instructional media. For the other courses they will take a part in course teams as the instructional designers.

Another important obstacle was the other ongoing projects in the University and the Faculty. Because of those, several facilities such as tv studios and printing office could not be used by the team, and some of the project members such as graphic artists and content specialists could not join the whole procedure. As a consequence of this, all the timing plans failed and left a few times –like 3 months- to design and development of the courses. So that, the Faculty administration has decided apply this project on mathematics, economics and business management courses. Now course teams are working on instructional materials of these courses.

Conclusion

Developments in communication technologies and instructional methods force distance education providers to change the way they try to help learners. Anadolu University as one of the biggest distance education providers in Turkey has been trying to adapt its distance education programs to this new situation occurred especially during 1990s. The University has developed a new distance education model and lunched a project to help the learners. This model includes use of textbooks, television programs, computer-based instruction programs on CD-ROMs and Web sites either together or alone depends on the learners ability to access the equipments necessary for the materials.

Although everything planned at the beginning of the project could not be done due to several reasons, it can be easily asserted that this effort has several important effects on Turkish distance education system.

First of all, it introduced the field and the process of instructional design to the people who are developing products (textbooks, web based education, computer based education, educational tv programs) for instructional purposes and unaware of instructional design. Also, it has revealed the strength of instructional design to the people who are aware of instructional design but do not appreciate it. Besides it gave a clear idea about what kinds of features a textbook should have and what sorts of processes should be completed during the development of an effective textbook. These are significant for the development of the instructional design field in Turkey. Now more and more people have started talking about systematic and systemic design of instruction.

Second, after this effort, both Faculty of Open Education and the University have appreciated the dynamic nature of distance education field and decided to keep up developments in the field. That means the Faculty is trying to improve its services through the effective use of instructional media and giving up not to looking at the reasons of low graduation rates. Thus, a new department, instructional design department, established under the Open Education Faculty and new instructional designers are employed.

However, all these are not enough. In order to remove all kinds of barriers on the applications of more effective, efficient, and appealing delivery methods and technologies, the administrators of the distance education providers must take serious steps.

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ACCESSING CBT LEARNERS' STUDY SKILLS

Leaunda S. Hemphill
Prairie State College

Purpose

The purpose of the study (Hemphill, 2000) was to determine if learners who were given individualized learner strategies based on a survey of their needs at the time of instruction score higher than those learners who were not given the strategies. A proof-of-concept learner profile instrument was developed to provide specific strategies to learners to help them increase their effectiveness in taking computer-based training (CBT) courses. The short survey assesses the learners' learning needs and generates a customized learner profile with individualized strategies for each learner's training needs, learning and environmental preferences, and optimum use of learner-controlled program features for the task at hand.

Rationale

In learner-controlled environments such as computer-based training, learner involvement is important to make the training meaningful. Unfortunately many learners are not capable of selecting appropriate learning strategies and software options that enhance their instruction (Clark, 1984; Yoon, 1994). Individual differences such as prior knowledge of related tasks and motivation for completing the task appear to be good predictors of future achievement (Jonassen and Grabowski, 1993; Garcia and Pintrich, 1995). Metacognitive strategies also allow learners to perform effectively in self-regulated environments (Gay, Trumball, & Mazur, 1991). Self-efficacy, cognitive strategies, and learning styles may also affect learning. A number of researchers (Hannafin & Sullivan, 1996; Nathenson & Henderson, 1980) have recognized the need for a preinstructional survey to assess the learners' individual characteristics and needs at the time of instruction and then provide the learners with a profile of individualized strategies for improving their achievement. Unfortunately, available learner surveys usually focus on the general prescriptive and evaluative purposes and are not appropriate for suggesting learning strategies for specific CBT training applications.

Procedure

The learner profile and survey instrument prototype was developed and then tested at three different colleges to determine if there was a relationship between the use of the suggested learner strategies and the learners' achievement on the posttest. All subjects took the learner profile survey, a pretest, the software-training course, a posttest, and an exit survey. The treatment groups also received learner profiles with individualized suggested strategies. The subjects in the treatment groups were rated on their compliance to the suggested strategies.

Data Analysis

The experimental analysis was as follows. Pretest and posttest scores were compared using a t-test and descriptive statistics, as was the length of time the subjects spent completing the training. The treatment group subjects' and raters' judgment of the subjects' compliance to following the strategies suggested were correlated. Descriptive statistics were done on the treatment group subjects' opinion of which strategies were the most useful and least useful. The instrument questions analysis was as follows. The distractability and perceptual modality construct survey items were analyzed using frequency data. A principal component analysis of the results of the pilot group was used to analyze the construct validity of the items related to the motivation, self-efficacy, and metacognitive awareness constructs. Those items that fit together in a common construct were used to determine which strategies the learners received in their learner profile.

Results and Discussion

The findings of the experimental study revealed that there was a statistically significance difference between the achievement score percent of subjects who followed the learning strategies suggested in their learner profiles and of subjects who were not given the strategies or did not use the strategies. The time spent in the course and the students' rating of the usefulness of the training course did not vary much across the groups.

Interestingly, the importance of learners complying with the strategies given and how to measure that compliance emerged as an important component of this study. The reasons for not following the instructions included the learners believing that the strategies were not useful to them, that working through a strategy took too long, and that they already had strategies they used and they did not want to try others. This study may encourage educators and developers to look more closely at suggesting strategies that are unique to each learner at the time of instruction and at the importance of having the learners use the suggested strategies.

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Online Staff Development: A Collaborative Approach

Dusti Howell
Bill Stinson
Emporia State University

Introduction

The public has raised numerous concerns regarding the quality of teaching in our schools. Political and professional factions have developed outcomes and standards for assessing not only student learning but also teaching performance. To enhance our K-12 educational systems, a variety of professional approaches are being explored and proposed. For example, the National Commission on Teaching & America's Future's 1996 report, "What Matters Most: Teaching and America's Future," outlines several changes in professional development programs. One change proposed is to organize teacher education and professional development around standards for students and teachers. Another suggestion is developing teacher academies, partnerships of schools/universities, and learning networks transcending school boundaries. Another example is the California Formative Assessment and Support System for Teachers (CFASST) which emphasizes the point of investing in teacher development and sustained examination of teaching performance over time will increase success for students and teachers alike (Oliebe, 1999).

According to the NASSP Bulletin, October 2000, "An Ambitious Vision of Professional Development for Teachers," quality teacher professional development has never been more important with the ever, increasing intensity of challenges and expectations for quality education. (Ganser, 2000). Darling-Hammond and McLaughlin (1996) expressed increasing teacher effectiveness and student achievement will require teachers to learn not only new skills and perspectives but also unlearn practices and beliefs that they have held onto for years. Guskey and Sparks (1996) use the terms – content, process, and context – as guidelines in developing quality professional development. Content in a professional development offering should deepen one's understanding of an academic discipline and teaching/learning principles. How these professional development experiences are planned, organized, and implemented reflects the process. Corcoran (1995) describes the most effective experiences in professional development occur when teachers are engaged in designed, intensive intellectual, social, and emotional experiences. The third quality, context, is aimed at providing an inservice environment for improving teaching through such things as accessibility to resources, meeting individual and organizational needs, and learning activities that are experiential in nature.

Professional development should reflect societal demands and skills needed for successful participation in one's culture for teachers and students alike. Technology has become the driver in much of our cultural environment. Teachers must not only understand the implications of our existing technological society but also use its tools in a variety of ways to show their usefulness in teaching and learning. Schofield (1995) describes a situation all too familiar that computers do not fulfill our expectations in schools because teachers are not shown how to integrate this new technology into their instruction, or into their students' learning processes. In describing a "generational model for professional development," Caverly, Peterson, and Mandeville (1997) cite we must not just "train" teachers in technology but "educate" then to think differently about how to use it in their classrooms. In a special eSchool News report, "Professional Development: Bringing Technology into the Classroom Effectively," it states that teachers use computers regularly at home and at school for lesson planning, correspondence, and personal business. However, the vast majority of them are not using them in their classrooms for instructional purposes (Levin-Epstein, 2000).

We need to insure that teachers are capitalizing upon the recent technological advances and tools for learning. When teachers are actively involved in using and applying technological tools in various learning situations, the possibilities of using technology in one's own classroom is enhanced. The following case study describes a collaborative attempt to incorporate the use of various technological tools in delivering an onsite version of a traditional professional development program.

A Case Study of Virtual Staff Development

The Flint Hills Special Educational Cooperative program director contacted teacher educators in the Teachers College at Emporia State University about the possibility of faculty being involved in a program called Fundamental 4MAT Level One training. This training was made possible through a grant addressing the integration of learning styles and the latest information on brain research into lesson planning. During this inservice training, corporate trainers from About Learning Inc., expressed an interest in making this training accessible to individual teachers in rural and international areas. Subsequent discussions involving Emporia State University professors, the Flint Hills Special Educational Cooperative, About Learning and MacLean Media led to a collaborative distance learning venture.

Each organization brought special ingredients to the potential development of the online delivery of Fundamental 4MAT Level One training. Emporia State University is the premier preservice/inservice teacher training institution in the State of Kansas. It is always looking for more effective ways to address needs and interests of teachers in the state. In addition, increasing interest in technology integration within the K-12 classroom setting and exploring the potential of a distance learning delivery model for teacher training are topics of continuing interest. The Flint Hills Special Educational Cooperative provides resources and in-services for eight local school districts. The Cooperative is always looking for a more effective way to serve a broad geographical area of clientele and researching ways to make staff development more economically and educationally effective. About Learning, Inc. is an established private corporation which developed a product called Fundamental 4MAT training. This training involves learning styles, diversity in the classroom and lesson plan design. About Learning, Inc. expressed an interest in economically delivering it's fundamental training to teachers in remote areas via distance learning. MacLean Media is a broad based company involved in producing a variety of educational materials. Among its clients is Aboutlearning, Inc.

After much discussion between the collaborative partners, a decision was made to pursue the possibility of converting a traditional face-to-face training program into an online experience. This staff development endeavor would utilize university faculty, school district personnel and corporate partners. To convert a traditional training program into an online experience created several concerns. The first concern was focusing on adapting written and audiovisual materials developed by Aboutlearning, Inc. into web course delivery system with CD-ROM supplementation. Emporia State University teacher educators investigated the four learning styles that are assessed within the 4MAT system, mapping out the various technologies that would be most appropriate for each style. Type One learners are the most social of the four types. They are interested in real time collaboration and communication within a classroom setting. It was felt that live chat, threaded discussion forums, video conferences, and e-mail would be tools that would allow Type One learners to operate within the comfort zone of their learning style. Type Two learners are more interested in the facts and information concerning the course. It was reasoned that online surveys, streamed lectures, formal discussions, and a very structured technology framework would benefit them the most. Type Three learners prefer to "just do it." They prefer to be active participants in a very structured learning process. Utilizing step-by-step tutorials, working with relevant software tools, and surfing the Internet in a structured way would be activities that would match best with their learning style. Type Fours are those who are constantly coming up with new ideas. They hate to be limited by a structured approach, preferring to allow their creative energies to flourish in anyway they like. Unstructured chat, open forum discussions, paint programs, and web page development outside of the typical template approach are activities that lend themselves to this type of learner.

Because of the interactive nature of the traditional training approach, it was imperative to provide cooperative learning and student interactive experiences, to preserve the integrity of Aboutlearning's program.

We chose to focus on several interactive vehicles in the development of this online course: e-mail, threaded forum discussions, and live chat. Live chat can be a difficult medium to utilize successfully, and at best is often labeled as controlled chaos. We chose to use live chat for topical discussions, mixed and homogenous learning style groups, and special invited speakers. It was made clear to the students that the chat rooms were also available to them whenever they wanted to work with their partners discussing their lesson plan projects.

One major component of the training required lesson plan assistance and evaluation opportunities. This is critical as students both develop and critique each other's final projects—a

4MAT lesson plan built around the four learning styles, including left and right brain activities. Students participated in a class brainstorming forum to create their initial ideas. They exchanged lesson plan ideas and critiques via e-mail with their partners. To facilitate this process, a separate website (http://www.lessonbank.com/) was developed to allow students a structured area to post and evaluate lesson plans. At this site their final postings are open for class review. Interestingly, this site is now a repository of hundreds of 4MAT lesson plans from both students and trainers available to anyone interested in lesson plan design.

What were the impressions of teachers in our case study toward online delivery professional delivery courses? Teachers liked the highly organized, logical structure of the online product. Having an overall course outline on the course website enabled teachers to plan ahead and have the option of anytime, anywhere to fit their daily schedules to complete assignments. Teachers favored the multi-dimensional resource applications of using traditional hard copy materials, links to internet information and a comprehensive CD containing self evaluative assessment instruments, graphical representation and audio-visual mini-lectures of related materials. Online forum discussions were looked upon favorably as opportunities to read and digest information before having to respond to classmates. Also, it was indicated that this form of discussion could not be dominated by a very few or curtailed by a busy onsite class schedule. It allowed everyone input on significant course issues – a true expression of diversity. Finally, many course participants expressed that online, distance learning was the wave of the future in education.

Besides several strengths, online delivery of Fundamental Level One 4MAT training had its shortcomings. The issue of no face-to-face interactions did bother some individuals. The isolation of reading and working alone existed and in some cases, created frustrations concerning the use of various technologies, difficulties with some CD applications, and general technological "glitches." In the same token, e-mail correspondence and responses between instructors and students alike were expected to be "instant" because of the speed of e-mail technology. Anything less than this speed of response created negative impressions. For some students, a web-based course tends to work against developing personal relationships with classmates since e-mail and forum discussion taketime to transcribe and to communicate with others.

Implications of Online Staff Development

The conversion of the traditional Fundamental Level One 4MAT training to an online delivery was considered successful. Much of this success was due to the already apparent structure of the onsite training program designed by Aboutlearning, Inc. which centered around learning styles and brain-based research. All that was necessary for the online designers was to employ appropriate technological tools for an effective online delivery. The virtual online course can address and retain the integrity of the staff development training if the technological tools are appropriate and implemented properly.

The National Board for Professional Teaching Standards (NBPTS) has designed not only certification standards for accomplished teachers but it has also been looking at teacher growth over one's professional life span. (Diez & Blackwell, 1999). Among the NBPTS charges is a recommendation to design graduate teacher programs with three critical factors which promote teacher growth: (1) reflection on practice, (2) systematic inquiry into practice, and (3) collaboration with others in meeting learner's needs. Reflection on practice, as cited by the NBPTS, is a teacher's ability to explain what they do and why they do certain things in their classrooms. For example, online forum discussions allowed all teachers time to reflect and express well-thought out responses. Challenging assignments and online discussion allows for the observance of diversity among teaching practices. Systematic inquiry into practice is illustrated by the emphasis in the online 4MAT training to incorporate learning style and left-right brain research into one's lesson planning. This quality was enhanced by an online lesson bank showing a variety of applications utilizing such research information. Collaboration with others in meeting learner's needs was accomplished by the diversity of teachers from different geographical regions and school settings, using such technological tools for lesson critiquing through partner e-mail, live chats on various teaching issues, and forums on best practices.

As Landeck (2000, p.42) states, "To meet the different learning styles and levels of tech expertise of their staff, many educational institutions are looking at a combination of online and face-to-face instruction." Online delivery systems can offer attractive educational and economical options to school inservice formats. Hybrid options need to be explored where onsite-online combinations can be

structured to fit individual school schedules, help to resolve critical need areas within the educational framework, and encourage cooperative collaborations on school staffs. In addition, hybrid options can alleviate administrative decisions involving financial issues concerning substitute teachers and teacher time away from the classroom, which inevitably effects student learning and security.

The time has come to consider online experiences as a viable option in professional development. Using today's technological tools incorporated into relevant, topical inservices for teachers, can not only insure an effective and economical delivery method of enhancing academic and pedagogical knowledges but also showcase the use of various technological tools to enrich the learning environments of students.

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KNOWLEDGE CONSTRUCTION COMMUNITY FOR ONLINE BOOK REVIEW

Chih-Hsiung Tu, Ph.D.
ctu@gwu.edu
Educational Technology Leadership
The George Washington University
2134 G Street, NW, Suite B03A
Washington, DC 20052

Michael Blocher, Ph.D.
blocher@nau.edu
CENTER FOR EXCELLENCE IN EDUCATION
P.O. BOX 5774
NORTHERN ARIZONA UNIVERSITY
FLAGSTAFF, AZ

KNOWLEDGE CONSTRUCTION COMMUNITY FOR ONLINE BOOK REVIEW

Chih-Hsiung Tu
The George Washington University
Michael Blocher
Northern Arizona University

Abstract

This project is the development of and the evaluation of an online educational book review site. Current book reviews cannot be published in a timely fashion. Usually, a single review is published representing the views of a single individual. Focusing on these two flaws, Online Educational Book Review Group publishes book reviews shortly after the book is available; it is a site that has feature reviews from a variety of perspectives, such as peer evaluations, invited reviews from well-known scholars, authors, publishers, and a discussion board area for anyone who wishes to make comments. It is operated entirely through a web-based database-driven design that supports the submission, review, editing, and publication processes online.

Introduction

Knowledge construction provides an ideal learning environment. Maurer and Davidson (1998) state: "The ultimate purpose of instructional technology's support of an exciting, quality learning curricula explicitly is to encourage children to discover basic data (facts), to integrate and interpret those data into information, and to apply that information into action to create knowledge (p. 4)." The current design of many online instructions features the distribution of static information, or a linear approach. This does not provide an opportunity for learners to pursue critical thinking or construct their own knowledge. Frequently, instructors, or content experts deliver the information, and the learners are denied an opportunity to contribute. This type of instruction is not individualized it is canned knowledge that is teacher-centered. Many instructions provide a long list of information without a search capability. Even when a search function is available, the search capability lacks focus, like Internet search engines and is a very time consuming process. Online bulletin boards and forums have been considered and implemented as knowledge construction learning environments. However, bulletin boards and forums only provide for the simple exchange of ideas. It ignores the sophisticated human thinking process and does not generate greater knowledge construction.

There are at least two disadvantages surrounding the current book review process: a) The reviews are not published in a timely fashion and b) there is no provision to support interaction. Publishing a book may take six to twelve months and with the current review process one to two years may have elapsed before a book review is published. The current schema only provides for the judgment of a single individual, without provision for the opinions of different people or an opportunity for interaction. The Online Educational Book Review Project is being formed to address the problems with the current book review process and to foster the formation of an authentic knowledge construction community.

Implementation Of Knowledge Construction

The Internet has become a primary source of daily information and possesses the potential for knowledge construction. An enormous amount of information is presented to us everyday. The Internet and WWW have been used for the presentation and delivery of information. Obtaining information has never been an extremely critical issue for people, particularly in a learning environment. Presently there is an avalanche of information that is constantly bombarding the populace. The shear excess is overwhelming and difficult for an ordinary human being to process. Shenk (1999)argued, "The Web right now is nothing more than a repository of convenience." (p. 22) This phenomenon also occurs in an online learning environment and poses a management problem for both learners and instructors (Tu, 2000). Current online instructional designs rarely support a learning style that engenders knowledge construction and fails to reflect the complexities of human thinking.

Shenk (1999)warned that users should be careful not to let the Internet govern the way they think. Frequently online communications occur to enable the simple exchange of ideas but the threading that occurs in an online bulletin board, for example, does not satisfy the complexity of human thinking. Learners lack the resources to determine the accuracy, timeliness, and social context of the information presented to them. These facts about the information received, accuracy, timeliness and social context, are critical to the process of knowledge construction.

Selective multiple resources play an important role in the knowledge construction process. An ideal learning environment engages students in deep thinking, provides multiple viewpoints, supports reflection, and offers frequent feedback and guidance toward a higher standard. For example, before reading or buying a book, people will normally gather information from different resources, such as their friends, colleagues, or relatives, "word-of-mouth" or "appeals to authority," or information may be received from multiple mass media reporting agencies. After gathering or receiving information from multiple resources, people will question, filter, claim, summarize, synthesize, predict, and generate a new set of knowledge. For example, in the class setting, recommended teachers provide texts and references in papers can help to filter the useful information from the useless information that may be provided from friends and colleagues.

Architecture Of The Internet

The architecture of Internet information delivery does not support information structure in a meaningful way. Therefore, developing tools, which foster self-improving and knowledge construction communities is very important. We should move beyond a forum for simply exchanging ideas and opinions, to structures, which rapidly capture and reflect knowledge and foster rapid accumulation and growth of a community's forces. In a learning community, one has the chance to make contributions and each contribution should generate values and more chances for knowledge construction. Learner's contribute and quickly find the best resources and opportunities to negotiate which items are key to knowledge mining and knowledge construction. Online database, XHTML, XML, and artificial intelligent (AI) are promising technologies to support knowledge construction environment.

Theoretical Framework

Automated Collaborative Information Filtering

Automated Collaborative Filtering of information (ACF) operates for the distribution of opinions and ideas in society and facilitates contacts between people with common interests (Chislenko, 1997). ACF enhances existing mechanisms of knowledge distribution, increases their efficiency, optimizes knowledge processing in the society, and accelerates the evolution of ideas in practically all subject areas; and, also, provides a superior tool for information retrieval systems that facilitate users' knowledge construction in a meaningful and personalized way. As an artificial system that integrates and processes knowledge of multiple human participants, ACF represents an intermediate stage between human and purely artificial intelligence and lays the foundation for the future knowledge construction.

People must possess both the necessary general knowledge and the special information relevant to their particular situation to make efficient personal selections. The collection of necessary information requires that one determine which items deserve their attention. This determination requires the exchange of personal experiences among individuals and the sharing of personalized advice on specific issues. When someone is confronted by the necessity of making a decision about an unknown situation, they can ask advice of their friends, and follow their suggestions. Here, one's circle of acquaintances effectively plays the role of an information filter, designating the most relevant options and providing leads for further exploration.

Recker and Lawless (1999) noted the potentials of implementing ACF into a learning environment. They argued that three issues are important in implementing ACF into instruction: a) Information about who contributes opinions is as important as the contribution itself, b) because contributors form a community, they have their own language and set of values; c) evaluating information sources and contributing rating is a metacognitive activity.

Potential of an Online Database for Knowledge Construction

Online databases provide opportunities to facilitate knowledge construction or knowledge mining. Learners are required to perform intentional searches and the information obtained is

contexturalized and personalized. This process encourages meaningful and higher-order thinking.

Student publishing and peer evaluation that occur on an online database (Tu, 1999) propagate improved quality in students' work. Jonassen, Davidson, Collins, Campbell, and Hagg (1995) argued that reflecting upon knowledge, stating learning intentions, and publishing ideas to a communal database produce cumulative, progressive results for the community/group.

Online Educational Book Review Project

The Online Educational Book Review Project is an Internet web site community that provides a forum for education book reviews by authors, publishers, professional book reviewers, and regular consumers. It offers each an equal opportunity to contribute their professional opinions.

To enter the online community, users are required to create a new account to become a community member and provide basic profiles that can be accessed by other community members. A logging on process is required when a member accesses the community. The open page working as information agent is customized to provide members with news, new review messages, and recommending activities according members' profiles etc.

Members can perform a search function to identify books and book review messages. The messages can be retrieved linearly or non-linearly. Members can contribute book review messages by completing the online form with fields for message title, keywords, and rating etc. All of procedures are performed on the browser and access is designed to be user friendly.

This knowledge construction community for book review is a learning community for anyone who is interested to learning about educational books. The target audience is composed of anyone who is interested in certain books or would like to discuss certain books. In phase one, classroom teachers can integrate this knowledge construction community into their class reading and reading report/summary/critique assignments. The book topics range from educational philosophical content to children's storybooks. A special arrangement can be made to accommodate class reading and report projects to a classroom community.

Conclusions

The Online Educational Book Review Project with web-based database utilization enhances an information filtering learning environment, supports the complex human information process, and fosters authentic knowledge construction. It is able to capture and reflect knowledge and foster accumulation and growth of a community's forces. This concept can also be implemented to enable learners and instructors to find and form collaborative teams around mutual goals, skills, and processes. New technologies, such as XHTML, XML and artificial intelligence, can be applied to the online database in the future.

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Unlocking the Gates to the Kingdom: Designing Web Pages for Accessibility

Steven C. Mills
University of Kansas

Although the use and availability of information resources on the Internet have skyrocketed over the last few years, cyberspace has predominantly been a domain of persons without physical or mental disabilities. While the Internet is easily accessible to individuals without disabilities, for all practical purposes the gates to cyberspace have been closed and locked for persons with disabilities. According to Tim Berners-Lee, World Wide Web Consortium Director and inventor of the World Wide Web, " *The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect* ."

The development of web pages that exclude persons with disabilities is unfortunate because these individuals often have the most to gain from Internet technology. Access to Internet technology has the potential to increase or enhance the productivity and independence of persons with disabilities. In fact, access to the Web may be more critical for individuals with disabilities than for the general population who can access information resources using conventional delivery systems. For example:

- Persons with disabilities may be location-bound. These individuals could use the Internet to shop for almost anything, research health questions, participate in on-line discussions, and contact friends and family.
- Persons who are blind may wait indefinitely for information to be made available in Braille or audiotape formats. These individuals could use the Internet to acquire access to the same information at about the same time it is available to persons who are sighted.
- Persons who are unable to hold a pen or use a mouse or keyboard could use speech recognition software to accomplish the daily routines and tasks of life.

While it is difficult to identify who uses the Internet, a variety of organizations and methods have been used to capture data that defines the audience of Internet users. Kaye (2000) analyzed national survey data to determine computer and Internet use among people with disabilities to determine that people with disabilities have considerably less access to the Internet when compared to people with no disabilities--11.4% versus 31.1%. Kaye concluded that while people with disabilities have the most to gain from Internet technology, the potential benefits of this technology are far from being realized. According to Kaye the problem is one of access that is a result of limited ownership of computer technology and specialized software by persons with disabilities and the lack of user interfaces that encourage use of the technology among people with disabilities.

The Georgia Tech Graphics, Visualization and Usability Center (GVU) conducts a large scale survey in April and October of each year (available at http://www.gvu.gatech.edu/ user_surveys/). Beginning with the second survey conducted in October, 1994, respondents were asked about their disability status. In October, 1994, 5.11% of the respondents indicated they had a disability. The tenth and latest survey conducted in October, 1998, indicated that the proportion of respondents with disabilities increased to 7.68%. In all GVU surveys the Vision category was identified by over half the respondents who indicated they have a disability. Although this survey confirms the incidence of Internet use among people with disabilities is low (approximately 7%-8%) when compared to the general population, these low numbers may be a self-fulfilling indication that people with disabilities do not have access to the Internet or have difficulties in accessing information on the World Wide Web.

Web pages often do not allow for the eventuality that some web surfers may not be able to see, hear, move, or process some forms of information. Other web surfers may have difficulty reading or comprehending text or may not be able to use a mouse or keyboard. Many experienced web designers and authors, however, are completely unaware of accessibility issues and, therefore, have little or no experience in making their web pages usable by persons who cannot see the screen or use a mouse the same way that the web page authors do. They have what Bartlett (1999) calls a "skewed mindset" in which they develop web pages to convey content visually. Jane Jarrow, president of

Disability Access and Information Support, explains that there is an art to making web pages more accessible "but people don't think to do it." (Carnevale, 1999).

Adjusting browser preferences and using assistive technologies may lower the access barriers to web pages, but the best method for providing equal accessibility is by building accessibility features into the web site itself (Casey, 1999). Much of what web page authors can do to make web pages more accessible is relatively simple and can be achieved through proper design strategies using the accessibility features of HTML 4.01 and other web authoring resources. Web pages that are accessible to people with disabilities are highly accessible to everyone. Thus, web accessibility is a design issue. Design strategies that create accessible web pages also facilitate the creation of well-designed web pages. Improvements to a web page or site that enable web surfers with disabilities to access it also improve the web page for all surfers.

The World Wide Web Consortium (W3C) has recognized a disparity in accessibility to the Web between persons with and without disabilities and has responded by developing a set of web page design standards that specifically address the issue of web accessibility. Web accessibility is based on design principles that provide for the development of web pages to accommodate the needs of a broad range of users, computers, and telecommunications systems without regard to age or disability. When a web site is accessible, anyone browsing the site should be able to gain a complete understanding of the information presented on the site as well as have an undiminished ability to interact with the site. The W3C has embraced the issue of accessibility through its Web Accessibility Initiative (WAI). The WAI has developed a set of guidelines, the Web Content Accessibility Guidelines, for use by web page authors to incorporate accessibility features into the design of web pages. The purpose of this paper is to describe web page design principles and strategies based on the WAI's guidelines that will facilitate the development of web pages that open the gates of the virtual kingdom to persons with disabilities.

The W3c Web Accessiblity Initiative

Who Is the World Wide Web Consortium?

In October 1994, Tim Berners-Lee, inventor of the Web, founded the World Wide Web Consortium (W3C) at the Massachusetts Institute of Technology, Laboratory for Computer Science (MIT/LCS). The W3C was created to promote and manage the evolution of the Internet and to ensure its interoperability. The W3C has more than 400 Member organizations from around the world and is financed by its members and by public funds. Membership in the W3C is available to any organization. Along with MIT/LCS in the United States, the W3C is jointly hosted at sites in France and Japan and W3C offices are located in 11 other countries.

W3C activities and other work are organized into four domains: 1) Architecture Domain to develop the underlying technologies of the Web; 2) Technology and Society Domain to understand ethical and legal issues from a new international perspective and in light of new technology; 3) User Interface Domain to improve user interaction with the Web including work on formats and languages; and 4) Web Accessibility Initiative to pursue accessibility of the Web through five primary areas of work: technology, guidelines, tools, education and outreach, and research and development. The W3C has published more than 20 technical specifications for the Web's infrastructure since its inception. Each specification not only builds on its predecessor, but is designed to integrate with future specifications as well.

The Web Accessibility Initiative

The Web Accessibility Initiative (WAI) is an official domain of W3C. The WAI works across all the other domains and works internationally in all three host sites of the W3C. The WAI is sponsored by representatives of web development industries, disability organizations, research organizations, and government. Some of the WAI sponsors include the National Science Foundation, National Institute on Disability and Rehabilitation Research, Microsoft, IBM, Lotus Development, and NCR.

To facilitate the efforts of promoting Web accessibility, the WAI joined forces with the W3C HTML Working Group in the design of HTML 4.0 and in December, 1997, HTML 4.0 became a W3C recommendation (see http://www.w3.org/TR/REC-html40/). In May, 1998, an official W3C recommendation for Cascading Style Sheets, Level 2, (CSS2) was issued (see www.w3.org/TR/REC-CSS2/). In May, 1999, the WAI issued the Web Content Accessibility Guidelines 1.0 (see www.w3.org/TR/WAI-WEBCONTENT/). These guidelines incorporated the recommendations of HTML 4.0 and CSS2 and were intended for use by all web content developers including page authors, site designers, and developers of authoring tools.

Web Content Accessibility Guidelines 1.0

The Web Content Accessibility Guidelines (WCAG) consist of 14 guidelines. Each of the guidelines of the WCAG is comprised of multiple checkpoints or sub-guidelines. Assigned to each of the checkpoints is a priority level that is based on the checkpoint's potential impact on accessibility. Priority 1 checkpoints are "must satisfy" requirements without which some groups will find it impossible to access information in a web page. Priority 2 checkpoints are "should satisfy" requirements without which one or more groups will find it difficult to access information in a web page. Priority 3 checkpoints are "may address" requirements without which one or more groups will find it somewhat difficult to access information in a web page.

The WCAG provide for three levels of conformity to the guidelines: Level A, AA, and AAA. For Level A conformity, all Priority 1 checkpoints are satisfied; for Level AA all Priority 2 checkpoints are satisfied; for Level AAA all Priority 3 checkpoints are satisfied. Conformance levels are cumulative. For example, Level AAA conformance would indicate that a web page conforms to Priority 1, 2, and 3 checkpoints. Web pages can display logos to indicate a claim of conformance to a specified level of conformity with the WCAG 1.0.

The WCAG are formulated around two general web page design strategies: *ensuring graceful transformation* and *making content understandable and navigable*:

3. Ensuring Graceful Transformation. Web surfers may operate in contexts very different from the one in which a web page is developed. Therefore, web pages should transform gracefully. A page transforms gracefully when it remains accessible despite any constraints that may include (though not be limited to) physical, sensory, and cognitive disabilities, work constraints, and technological barriers. For example, a web surfer may not be able to see, hear, move, or use a keyboard or mouse, or may have difficulty reading or comprehending text. The surfer may have a small screen, a slow Internet connection, an early version of a browser, a different browser, a voice browser, or a different operating system. For web pages to transform gracefully, structure must be separate from presentation. Structure refers to the logical organization of a page while presentation refers to how a page is rendered, such as print, computer graphics, text, or synthesized speech. The theme of graceful transformation is addressed primarily by Guidelines 1 to 11.

- Making Content Understandable and Navigable. Web page authors should make page content understandable and navigable. The language of a web page should be clear and simple, but also provide understandable mechanisms for navigating within and between pages. Providing navigation tools and orientation information in web pages maximizes accessibility and usability. Not all surfers can make use of visual clues such as image maps, proportional scroll bars, side-by-side frames, or graphics that guide sighted users with graphical desktop browsers. Web surfers may also lose contextual information when they can only view a portion of a page, either because they are accessing the page one word at a time as with a speech synthesizer or a Braille display, or one section at a time as with a small or magnified display. Without orientation information, users may not be able to understand very large tables, lists, or menus. The theme of making content understandable and navigable is addressed primarily in Guidelines 12 to 14.

Designing Accessible Web Pages

Principles of Accessible Web Design

The WAI has produced an extensive set of guidelines for authoring accessible web pages. Since the Guidelines are a technical document that may be somewhat overwhelming to a beginning web author, the HTML Writers Guild (see www.hwg.org) has proposed six principles of accessible web design upon which the WCAG were written. The following principles are the basic rules for accessible design that formed the specific instances described in each individual entry in the guidelines (Bartlett, 1998):

1. Create pages that conform to accepted standards. Use the W3C recommendations for WCAG, HTML 4.01, and CSS2 for designing web pages.
2. Know the difference between structural and presentation elements. For example, <EM>, <ADDRESS>, and <LI> are structural elements while <B> and <CENTER> are presentation elements. Use HTML structural elements to convey page content and style sheets to convey page presentation and formatting.
3. Use HTML 4.01 features to provide information about the purpose and function of elements. Attributes such as TITLE and CLASS allow the web author to provide additional information on the function and meaning of particular tags, thus increasing the accessibility of the page.
4. Ensure that pages can be navigated by keyboard. For example, using client-side image maps with the ALT tag and ACCESSKEY attribute will accommodate keyboard navigation by a browser agent.
5. Provide alternative or text-based methods to access non-textual content that includes images, scripts, multimedia, tables, forms, and frames for user agents that do not display them.
6. Be careful of common programming techniques that can reduce the accessibility of your site such as ASCII art, blinking text, or adjacent links that are separated by non-printable characters.

HTML 4.01

HTML 4.01 is W3C's recommendation for the latest version of HTML. HTML 4.01 was released on December 24, 1999, and fixes bugs in the HTML 4.0 specification, which for instance, omitted the name attribute on the IMG and FORM elements. HTML 4.01 defines the semantics and data types for HTML. HTML 4.01 includes mechanisms for style sheets, scripting, embedding objects, improved support for right to left and mixed direction text, and enhancements to forms for improved accessibility for people with disabilities. HTML 4.01 is specified according to three variants:

1. *HTML 4.01 Strict* excludes the presentation attributes and elements that the W3C expects to phase out as support for style sheets matures. Web authors should use the Strict DTD when possible, but may use the Transitional DTD when support for presentation attribute and elements is required.
2. *HTML 4.01 Transitional* includes presentation attributes and elements that W3C expects to phase out as support for style sheets matures. Web authors should use HTML 4.01 Strict when possible, but may use Transitional when support for presentation attributes and elements is required
3. *HTML 4.01 Frameset* is used for documents with frames. This variant is identical to the HTML 4.01 Transitional except for the content model of the "HTML" element: in frameset documents, the "FRAMESET" element replaces the "BODY" element.

The web author designates which of these variants are used on a web page by inserting a line called a Document Type Definition (DTD) at the beginning of the document. This line is used by the validation service to determine the variant of HTML 4.0 that is used on a page. Each variant has its own DTD. For example, the DTD for a web page that is HTML 4.01 Transitional is:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
```

The complete HTML 4.01 specification is available in English in several formats, including HTML, plain text Postscript, and PDF at http://www.w3.org/TR/1999/REC-html401-19991224.

Cascading Style Sheets

Cascading style sheets (CSS) facilitate accessibility to web pages by separating document structure from presentation. CSS2 is the current specification for cascading style sheets and is a recommendation

of the W3C. A discussion of the accessibility features of CSS2 may be found at www.w3.org:80/TR/CSS-access.

Style sheets were designed to allow precise control over page presentation properties such as character spacing, text alignment, object position on the page, audio and speech output, or font characteristics apart from markup. By separating style from content, web authors can simplify the HTML in their documents while making the documents more accessible at the same time. CSS facilitates accessibility in several ways:

- **Tag misuse**. CSS2 allows precise control over spacing, alignment, and positioning, thus, eliminating the practice of misusing a structural element for stylistic effects. For example, the BLOCKQUOTE and TABLE elements in HTML are intended to mark up quotations and table data, but are frequently used to create visual effects such as indentation and alignment.
- **Image misuse**. CSS2 positioning properties eliminate the need for invisible images to position content.
- **Font control.** CSS2 provides for precise control over font size, color, and style.
- **User override**. CSS2 allows users to override author styles and to view documents with their own preferred fonts, colors, and styles by specifying them in a user style sheet.
- **Orientation and navigation**. CSS2 provides support for automatically generated numbers, markers, and other content that assists surfers in staying oriented within a document. Long lists, tables, or documents are easier to navigate when numbers or other contextual clues are provided in an accessible manner.
- **Aural style sheets**. Aural style sheets are used to specify how a document sounds when rendered as speech. Aural style sheets allow authors and users to specify properties such as the volume of spoken content, background sounds, and spatial properties for sound that can add effects to synthesized speech. These effects correspond with those achieved with styled fonts for visual output.

Style sheets minimally should provide declarations for all structural elements used in the HTML source. Web pages using CSS essentially need to be unadorned or unformatted. To create a web page with CSS, use HTML code with few or no *deprecated* HTML tags. Deprecated tags are HTML tags that are part of the HTML specification but are expected to be phased out of subsequent versions of HTML.

Style declarations can be embedded at the beginning of an HTML document using a STYLE tag (e.g., <STYLE> </STYLE>) or embedded inside elements in HTML (called inline styles) using a STYLE attribute (e.g., <H1 STYLE="text align: center">Heading Level One</H1>). Style sheets external to HTML documents can be linked to these documents. All methods of style declarations can be used in a single web page.

Validation Services

BOBBY. Bobby (http://www.cast.org/bobby/) is a web-based tool that analyzes web pages for accessibility according to the WCAG. Bobby is offered as a free public service by the Center for Applied Special Technology (http://www.cast.org) to facilitate its mission to expand opportunities for people with disabilities through the innovative uses of computer technology. Although Bobby is an on-line, web-based validation service, Bobby also requires a manual examination of those components of a web page that Bobby cannot examine automatically.
Bobby's analysis of accessibility is based on the W3C's Web Content Accessibility Guidelines. The combination of automatic and manual examination of a web page makes Bobby Approved status equivalent to WAI Conformance Level A--that is, all Priority 1 items have passed.

For example, to become Bobby approved, a Web site must:

6. provide text equivalents for all non-text elements (i.e., images, animations, audio, video)
7. provide summaries of graphs and charts
8. ensure that all information conveyed with color is also available without color

9. clearly identify changes in the natural language of a document's text and any text equivalents (e.g., captions) of non-text content
10. organize content logically and clearly
11. provide alternative content for features (e.g., applets or plug-ins) that may not be supported

Bobby also analyzes web pages for compatibility with various browsers. Analysis is based on documentation from browser vendors when available. Bobby automatically checks sites for compatibility with HTML 4.0. For accessibility and tag compatibility with browser specifications other than HTML 4.0, use the Advanced Options of Bobby. Once a web site receives a Bobby Approved rating, it is entitled to use a Bobby Approved icon on its web pages. Additionally, a Bobby approved web site is eligible for listing in the Bobby Approved Database at http://dev.cast.org/bobby/approved_database.cfm. This database may draw positive attention to a Web site and help others understand that Web accessibility is an important initiative.

Bobby is only one step in the process of making a site accessible to as many people as possible. CAST recommends that web developers use Bobby as a first step to ensure accessible web page design. Other web-based tools are available to analyze web pages for their conformance to the accessibility guidelines, HTML 4.01, and CSS2:

1. **HTML 4.01.** To validate a web page for HTML 4.0, the page must contain a Document Type Definition (DTD) at the beginning of the page. The validation tool knows which variant of HTML 4.01 is being validated based on the DTD. The HTML validator can be accessed at http://validator.w3.org/. The HTML validator provides validation by URL or by uploading HTML into the validator. Web authors can validate the HTML used in the web pages for conformancy with the HTML 4.01 recommendation, and web pages that validate can display a logo to identify the conformance claim.

2. **CSS2.** A validator for CSS2 can be downloaded from http://jigsaw.w3.org/css-validator/ or validated by URL, by entering CSS text into the validator, or by uploading CSS text into the validator. Validating style sheets requires the use of valid HTML. Web authors can validate the style sheets used in the web pages for conformancy and style sheets that validate can display a logo to identify the conformance claim

Validation Procedures

Validation of accessibility is a continuous process. Validation of accessibility should be performed with both automatic tools and manual examination. Validation procedures should be followed even at the earliest stages of web page development where accessibility issues are easier to identify, correct, or avoid. To assist in web page design and validation, the W3C provides a Checklist of Checkpoints for Web Content Accessibility Guidelines 1.0 at http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/full-checklist.html. A table containing a checklist with the Priority 1 Guidelines is provided at the end of this article.

When developing web pages, the following validation methods will facilitate the development of accessible web pages that conform to the WCAG:

9. Use an automated validation tool and browser validation tool but remember that automated tools do not address all accessibility issues.
10. Validate source syntax (HTML, XML, etc.).
11. Validate style sheets (CSS2, etc.).
12. Test web pages with a text-only browser.
13. Test web pages with multiple graphics browsers and browser versions.
14. Test web pages with browser or screen reader.
15. Test web pages with multiple screen resolutions.
16. Test web pages with spelling and grammar checkers

A Quick Guide For Developing Accessible Web Pages

The following web page authoring tips provide a quick guide for establishing WAI Level A conformity (see checklist at www.w3.org/TR/1999/WAI-WEBCONTENT-19990324/full-checklist.htmland) and Bobby Approval of a web page. A more comprehensive discussion of techniques that implement the checkpoints is defined in the WCAG at http://www.w3.org/TR/WAI-EBCONTENT-TECHS/. Additionally, The W3C has developed and published a downloadable *Curriculum for Web Content Accessibility Guidelines 1.0* slide set at http://www.starlingweb.com/wai/wcag/. Several of the following examples are provided in the example set of this curriculum at http://www.starlingweb.com/wai/wcag/oversam.htm *(Chuck Letourneau & Geoff Freed, Copyright © 2000 W3C*.

Using Images in a Web Page

- Provide client-side image maps instead of server-side image maps except where the regions cannot be defined with an available geometric shape. When using image maps, use the ALT tag for each image and image map link and provide a text version of the links of an image map elsewhere on the web page. For a client-side image map, describe the destination to which each active area will link. For example:

```
<A HREF="../index.html">
    <IMG SRC="../gifs/logo.gif" WIDTH="630" HEIGHT="111" ALIGN="top" border="0"
    naturalsizeflag="3" ALT="Graphic Header Image with Mapped Links to other pages"
    USEMAP="#insideheaderb55d8d01">
    <MAP NAME="logo55d8d01">
            <AREA HREF="newsletter.html" COORDS="534,85,625,108" SHAPE="rect"
            ALT="Link to Newletter Page">
            <AREA HREF="staff.html" COORDS="462,86,533,108" SHAPE="rect"
            ALT="Link to Staff Page">
            <AREA HREF="syscomp.html" coords="100,85,193,108" SHAPE="rect"
            ALT="Link to System Components Page">
    </MAP>
</A
```

- Bitmapped text images cannot be read by a screen reader and should also use the ALT tag. For example,

```
<IMG SRC="wai-lg.gif" ALT="Graphical Link to Web Accessibility Initiative">
```

- Images or buttons with links should be large enough to allow surfers who use an alternate type of pointing device with their computer to easily select the image.

Using Tables in a Web Page

a. Use tables primarily to convey statistical data or organized information. For data tables that have two or more logical levels of row or column headers, use markup to indicate data cells <TD> and header cells <TH>.

b. Restrict the use of tables for layout of web pages. Use Cascading Style Sheets to layout and format text and images on a web page instead of tables. If a table is used for formatting text, use the SUMMARY tag. For example:

```
<TABLE width="640" border="0" CELLSPACING="0" CELLPADDING="4"
SUMMARY="This table is for formatting purposes only.">
```

c. If tables are used for formatting and placement, test them in a text-only browser such as Lynx to verify that a text-only browser will display your content properly or with a browser reader to determine that the layout of your web page is comprehensible to users of assistive technology.

Using Frames in a Web Page

- Title each frame in a web page to facilitate frame identification and navigation. For example:

<FRAME SRC="tocleft.html" TITLE="Table of Contents Frame">

- If possible, do not use frames in a web page because frames cause difficulty in printing, viewing, and navigation for all users, not just those with physical disabilities.

Using Applets and Scripts in a Web Page

a. Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported.

b. If pages are not usable when turning off applets and scripts, provide equivalent information on an alternative accessible page.

Using Multimedia in a Web Page

- Provide an associated auditory description or text transcript and provide a link to the text transcript for the important information of a multimedia presentation.

- Synchronize captions or auditory descriptions of the visual track for any time-based multimedia presentation with the presentation. At present there are three formats or languages that support the ability to synchronize equivalent alternatives. These formats are Apple's QuickTime, the W3C's SMIL (Synchronized Multimedia Integration Language) and Microsoft's SAMI (Synchronized Accessible Multimedia Interchange).

- Interactive content that requires the surfer to press a key should not be time-limited and animations that use text should show the text long enough for a slow reader to read it.

Using Alternative Web Pages

1. If it is not possible to create an accessible page, provide a link to an alternative page that uses W3C accessibility technologies, has equivalent information and functionality, and is updated as often as the original page. Because it is difficult to keep alternative pages up to date with the full content of the original page, alternative pages should be provided only after all other pertinent techniques outlined in the WCAG have been attempted. One common way to give surfers a choice is to use the following HTML near the top of an opening page:

   Welcome to the Web Accessibility Page!
   <A HREF="textversionpath/textversionpage">For a text version of this site, follow this link.</A>

2. Provide an alternative to web form submission such as phone number, fax number, e-mail address, or postal mail address to submit information. Even though a form may be accessible, there may be other ways of filling it out without using the web that are more convenient and less time-consuming for the surfer with disabilities.

Using Color and Backgrounds in a Web Page

1. Use adequate contrast between text and background colors as well as colors used in graphics. Dark text against a light background provides the most contrast for people with low vision. Do not use color to convey information unless the information is also clear from the markup and/or content of the displayed text.

2. Avoid using busy patterns or brightly colored background images. Do not tile an image as a background that will distract from the text or make it difficult to distinguish between the background and foreground elements.

3. Make sure your web pages can be viewed on a monochrome or grayscale monitor. A web page that can be viewed in grayscale or monochrome can also be printed without loss of information.

Using Hyperlinks in a Web Page

a. Use text for links that make sense when read out of context. For example, a link that says "Click Here" has no meaning out of context. Link text should be descriptive, yet not too long, for it may cause difficulty for screen-enlarging software:

```
<A HREF="access.html">Follow this link to the Web Accessibility Page.</A>,
```

displays like this on a web page:

Follow this link to the Web Accessibility Page.

While HTML code like this:

```
To go to the Web Accessibility Page, <A HREF="access.html">click here.</A>
```

displays like this on a web page:

To go to the Web Accessibility Page, click here.

b. Insert printable, non-link characters between links that are adjacent, such as an asterisk (*) or a vertical line (|). Visually impaired users and screen readers may have difficulty distinguishing between links that are separated only by a space.

To display text links like this:

[Goals | Components | Training Calendar | Best Practices | Resource Center | Staff | Newsletter]

use HTML code like this:

```
[<A HREF="goals.html">Goals</A>
| <A HREF="syscomp.html">Components</A>
| <A HREF="training.html">Training Calendar</A>
| <A HREF="bestdocs.html">Best Practices</A>
| <A HREF="rescenter.html">Resource Center</A>
| <A HREF="staff.html">Staff</A>
| <A HREF="newsletter.html">Newsletter</A>]
```

Conclusion

As the use of the Web is perceived to be an effective tool for dissemination of research findings or for the provision of asynchronous instruction, the issue of accessibility of web page information will become more and more relevant. The W3C has embraced the issue of accessibility through its Web Accessibility Initiative and essentially thrown open the gates to the virtual kingdom for persons with disabilities. Web accessibility is a design issue and the benefits of developing accessibility features in web pages easily offsets the additional time and labor requirements for authoring accessible web pages. Because of the commitment of the W3C to web accessibility and the availability of resources and tools for web authors to use in the development of accessible web pages, new and experienced web authors have a compelling mandate for including accessibility features in the design of web pages.

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ONLINE FORUM INSTRUCTIONAL GUIDE

Ismail Elmahdi
Ohio University

Introduction

This guide provides suggestions to faculty using online forum to conduct effective online discussion. This guide was developed in response to the growing number of instructors at Ohio University who are considering or making the transition to using an online conferencing tool for course discussion. Online teaching is becoming a part of the educational culture with its own unique characteristics, which need to be considered in order to be successful.

This instructional guide is based on the experiences of some online teachers and students at Ohio University. While this guide is not a prescription for conducting perfect online discussions, it offers practical information for instructors who want ideas and techniques to teach online more effectively. It is not a user guide, but it is a useful collection of conceptual issues and online instructional tips organized into the following four areas: pedagogical, social, managerial, and technical.

1. Pedagogical Aspects:

➢ Instructor as Facilitator

In online teaching the role of the teacher should be transformed from a transmitter to a facilitator, collaborator or moderator. In this role there is a partnership between the faculty and student in which they work together to achieve the course objectives. The following are some suggestions:

The Role of the Facilitator:

- The primary role of the instructor in online teaching is to create a learning environment that motivates the students to construct meanings through interaction with each other as well as with their instructor. The instructor and the student should engage in an active dialog.
- Online instructors should avoid the authoritative style especially when working with adult learners.
- It is the responsibility of the facilitator to build the understanding of conversational discussion and to move students away from the debate style, which normally leads to flaming. To do that the instructor needs to encourage students to stick to the subject of a particular line of discussion.

What the facilitator should do:

- In online teaching the facilitator is responsible for keeping discussions on track, contributing special knowledge and insights, weaving together various discussion threads and course components, and maintaining group harmony.

- To encourage participation the online instructor should introduce various options of learning that stimulate learner participation and interaction.

- The facilitator should move away from the correspondence model, in which students send in their assignments to the instructor who then sends back their feedback, to a model that would allow dialogue and interaction. The online discussion forum should allow participants' personalities to come across the medium.

- One of the biggest mistakes that an online facilitator should avoid is to treat the students as children. In fact, in the case of adult participants, some online students may be as knowledgeable

as the facilitator in a specific subject; therefore, the facilitator should utilize this situation by asking such students to share their experience with their classmates.

> **Instructor Visibility:**

Instructor visibility is a determinant factor for the success of online discussion. Therefore, every online instructor needs to be aware of different ways and means by which they can increase their visibility in their classes. For example the following are some different type of messages that online instructors can send to increase their visibility.

- Content-related messages (i.e. handouts, discussion questions, notes).
- Rules and Guidelines (i.e. grading procedures)
- Technical tips (Internet addresses, information about how to send an image as an attachment, information of how to paste text or image).
- Responses (answers to students questions, feedback).
- Announcements (projects and assignments due dates, information about guest speakers).

The instructor can be visible by modeling a high level of participation, which often encourages the students to enhance their own participation. The instructor who shows low visibility in online discussion normally gives students an excuse to reduce their participation, or even not to show up. They assume that their instructor will not grade them down because he/she is behaving in the same way. Another reason that makes instructor visibility crucial in online discussion is to minimize the sense of isolation that distant students normally encounter. Students feel secure, connected and as if they are working in a collaborative environment with other students and with their instructor if they find a number of new messages in the forum. Instructor visibility provides distant students with a sense of belonging to a body that supplements the traditional classroom. If for any reason the instructor has to be absent he/she should notify the student as soon as possible and look for other ways of communication since the online discussion continues beyond class meeting time. (See Figure F1 for an example).

Figure F1

> Hi Everyone,
>
> I wanted to let you know that I will be out of town Wed - Sunday. I should have email access most of that time and do plan to check my email daily except Wed and Sunday. I will likely not be checking ACT until I return.
>
> Please allow a couple days for me to reply to your emails, though - just in case there are technical problems.
>
> I will be in my office the rest of today - so you can email me until 5ish today without any problems.
>
> I hope this doesn't cause any major problems.
> Chandra

> **Feedback:**

- Timely feedback assures students that their instructor is focusing on them and following what they are doing. On the other hand, delayed feedback leads students to think that their instructor is not involved enough in their learning process. Therefore, instructors should expect to communicate regularly and frequently with students.

Diplomatic feedback is motivational and will encourage students to be enthusiastic and confident that they will succeed online. When the instructor wants to write **critical** feedback it is crucial for him/her to send a well-worded email message that preserves student dignity and prevents embarrassment. **Warm** feedback indicates that the instructor understands and remembers that it is

people who are engaging in communication and not software. However, if a student proves to be disturbing to the online discussion he or she should receive a positive but clear message indicating that the conduct is not appropriate. Figure F2 is an example of an effective, critical and diplomatic feedback that conveys to students that their instructor is interested in their contributions.

Figure F2

> Ismail,
>
> This is a very well thought out response. I really like that you point out the importance of the attitudes – if the learners are not ready or do not see the importance of this training, that is a critical non-instructional barrier to learning.
>
> I find it interesting that you don't ask any questions in the needs analysis to determine if there are other ways than just inservice days to support this effort.
>
> I do like that you suggest really exploring the goal of technology literacy as that may have very different definitions from different parties. (The principal may think something very different from the teachers and the ID team may have a completely different idea.)
>
> Chandra

➢ **Online Materials**

Although the online instructor's role is basically to facilitate, he/she also should provide relevant materials to enhance the learning process. As with the student discussion, the materials need to be focused on the coursework. To help make material relevant, Instructors should develop questions and activities for learners that relate to the students' experiences. After instructors have the biographical information of their students they may be able to include material that would appeal to the learning interest of their students.

It should be made clear whether posted material is mandatory or optional so that students may mange their time and prepare for responses. Posting online material such as Mini-lectures and handouts requires careful editing since they should enhance the face-to-face lectures rather than offer a replacement. Also, all postings should be checked for accuracy regularly. Students will become frustrated with the instructor who posts a website address that is no longer there.

Be sure to edit all online course materials for correct information. All online documents should be clear and detailed, as well as containing a full description of what is required from students and the due dates of these requirements. The instructor should have class materials uploaded and tested 2 -3 days before the day in which students have to check it.

2. Social Aspects:

Online education should be looked upon as a social construct where learning is supported by technology.

- To help build a sense of community and reduce the feeling of isolation, the facilitator should encourage students to post their biographical information in the first online activity.

- Interpersonal-communication techniques are particularly important in an online environment where there are fewer verbal and physical cues to help smooth dialogue.

- The energy and personality of an online instructor can also be effectively communicated through the warmth he/she brings to the forum. Many online facilitators believe that increasing warmth online is a way to reduce the psychic distance among the forum participants.

- Another way to bring warmth to the forum is by treating students uniquely by identifying them by their names.

- Creating a friendly, social environment that promotes learning essential for the success of an online forum. Promoting collaborative work, and providing the opportunity for other interactions through the development of a café where students are free to discuss intellectual and personal matters on their own can achieve this goal.

Figure F3

> **Café**
>
> Area for informal discussion
>
> Use this space to talk about whatever you want! Since you'll be seeing your team members often, but not others in the class, this is a great place to keep in touch.

3. Managerial Aspects:

Managing an online conference can be time consuming and labor-intensive, therefore, instructors who want to use online discussion for the first time should be aware and prepared to accept the challenge. Once the discussion starts students can create many messages that could overwhelm the instructor. The following suggestions may help you avoid common pitfalls.

➢ **Organizational:**

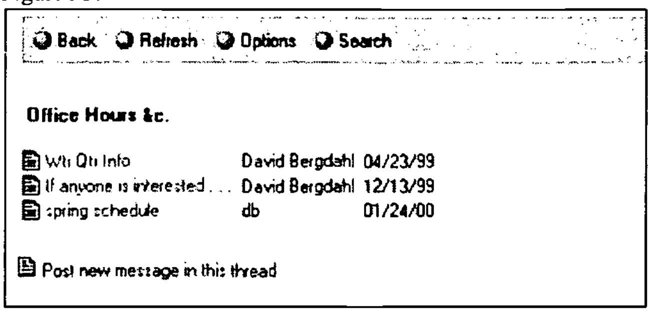
- Putting together an organized syllabus that establishes guidelines and provides students with clear and detailed information can save online instructors a lot of time and effort. The syllabus should state in detail what is expected when students have to give feedback to the class. It may be useful to provide both the week and the due date for assignments rather than just writing "the feedback is due on Monday."

- Novice online instructors often underestimate the time and effort required for planning, developing and putting together online course materials. Many online instructors emphasize that lead-time to prepare an online course is substantially greater than they anticipated. Therefore, careful planning is essential.

- A classroom with 20 students or more will likely generate a huge number of messages in a short time. Breaking the class into small groups with 5-7 students will ease the management issues. Furthermore, it will encourage more interactions among students by keeping the number of messages smaller and the discussion more on track.

- For organizational purposes instructors may create an area in which they can post announcements, contact information, office hours, and links to related web sites. The idea announcement can be seen in Figure M4.

Figure M4



➢ **Procedural:**

- Depending on the objectives of the online conference the instructor may decide to encourage informality in discussion. For example, the instructor may decide to let participants know that perfect grammar and typing is less important than making their ideas and arguments clear.

- It is recommended that the instructor respond to students' postings within 72 hours. The instructor may not send feedback to every student, however he/she can respond to several students at once by weaving their contributions together or summarizing the discussion.

- The policy of participation should be clearly stated in the syllabus. Both the importance of participation to the learning experience, as well as how participation will contribute to the student grade, should be emphasized. The instructor also needs to address in the syllabus the issue of late assignments and how he/she will handle them.

- To ensure thoughtful active discussions, students should be graded on their participation in them. This grade should be at least 20-25% of the total grade for the course.

➢ **Administrative:**

- When a discussion thread or a conference has served its purpose the instructor should be decisive in ending it.

- Students can be given an opportunity to lead, moderate, or assist in directing the discussion. The instructor may ask students to take turns to experience administration responsibility.

- In any online conference there are two extreme cases: an active participant who appears above the class level and an invisible member who contributes little to the discussion. The instructor needs to privately contact these members to ask the first to wait a few responses before contributing (see example M1) and to ask the second to participate more actively (see example M2).

M1	**M2**
Overachiever	**Lurker**
Mary, I like your thoughtful and critical reflections for the discussion topics. My only concern that your classmates are left behind and they have little to add to the discussion. I'd appreciate if you'd slow down a little bit so that your classmates can give it a shot. Thanks	John, I am a little bit worried about your contribution to the discussion forum. You have only posted one message in the last two weeks. Is there any problem that is holding you back from the class discussion. You need to move forward and to catch up with the group. Just remember that 25% of your grade comes from your participation in the discussion. Thanks.

- Conflict may erupt in online discussion, especially when the topic of the discussion is somewhat controversial. In many cases that can lead to "flaming". These remarks are not productive and may destroy the discussion. To guard against conflicts instructors need to set up norms and rules for the online conference that lay the foundation for a conflict management strategy. For example, the instructor can set a rule at the beginning of the conference to asking students to respect all opinions and not impose their views on others.

4. Technical Aspects:

In an online environment, problems related to hardware and software will likely arise. So, while remaining focused on the learning process, the online instructor must develop a working understanding of the technology s/he is using.

- The instructor should provide students with a user guide or website for the online conference that addresses both the content and the common technical problems. Novice users need time so that they can be comfortable with the technology. Therefore, the instructor should give students adequate time to learn the system before they participate

- Before starting an online conference instructors need to acquire the appropriate training in configuring, manipulating, and managing the conference. A step-by-step, face-to-face tutorial for novice computer conference administrator is recommended. The instructor should be aware of who is available for technical support beyond his/her technical skill. Contact information about the technical support personnel should be made available to students in the syllabus.

- Using a graduate or teaching assistant who has technical skill is important for the success of the conference. Graduate or teaching assistants can help with technical issues, as well as sharing administrative and teaching load. For example, a teaching assistant can reply to many technical questions or send feedback related to the discussion, or even step in to direct the discussion in the instance of the instructor's absence.

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CONTEXTUAL CONSIDERATIONS FOR TEACHING ONLINE AT THE POSTSECONDARY LEVEL

Salley Sawyer
University of Nevada
Joi Moore
University of Missouri

Designing an online class guided by principals of learner-centered instruction at the postsecondary level is a daunting challenge for new professors facing the demands of a tenure track position. The case study identified challenges faced by a new professor teaching an online course. This study found an online environment presents challenges unique to the technology and recommends that university administrators must recognize such challenges in order to encourage pedagogically sound online instruction.

The Study's Purpose

This paper presents the findings of a pilot project on two junior faculty's experiences with online course development and teaching in a university setting. The study's purpose was to identify contextual issues faced by new, untenured university faculty. Often junior professors are learning to teach in the face-to-face environment as well as learning to teach in the relatively new online environment. Additionally, the current emphasis on integrating technology into postsecondary teaching practices as evidenced by the Pew Symposia in Learning and Technology (http://www.center.rpi.edu/PewSym1.html) and the academic reward system as evidenced by the tenure process can mean that new faculty often encounter overlapping and or competing demands on their time and efforts as they seek success in meeting these two challenges. This study was designed to identify and describe the contextual experiences of junior faculty as they developed and taught online courses. The study's purpose was to identify and to describe those experiences in ways that would be useful to academic administrators, and in ways that would provide a robust basis for conducting a larger descriptive study.

The researchers designed a qualitative case study examining two professors who were in the mid stages of the tenure process, who had experience teaching courses online and face-to-face, and who facilitated active, meaningful learning that can be termed learner-centered instruction according to Branch (1995) and McCombs and Whisler (1997). The researchers' primary purposes were:

- To clarify contextual issues that affect a professor's ability to successfully integrate online teaching technologies into instructional practices that support active and meaningful learning
- To describe the professors' perceptions and experiences in online teaching

The researchers' secondary purposes were:

- To identify any additional data sources that would provide a fuller description of this study's area of interest
- To develop useful questions in order to construct a larger study that will continue to further define critical issues

Research Method
Qualitative Case Study

Participant Selection

The research design selected for this study is a qualitative case study following the guidelines for a case study as explained by Merriam (1998). The case is bounded by the area of interest, the focus of the research questions, and by the selection of the participants. Based upon LeCompte and Preissle's (1993) recommendations for participant selection, selection criteria were established. The two participants selected for the study met the following qualities, they:

- Valued and followed good teaching practices as described by Chickering and Gamson (1987) and McCombs and Whisler (1997).
- Were in a tenure track position and were in the process of going for tenure

- Were developing their experience in teaching with online technologies
- Had a personal interest in becoming better at teaching with online technologies
- Were teaching at two large universities that have officially adopted a course management software
- Were teaching an online class in two different disciplines
- Represented the use of two different brands of online course software

The two participants agreed to participate in the pilot study because they had a personal interest in the topic. When the data were collected and transcribed, the researchers assigned pseudonyms to the two participants. The transcribed interviews were returned to the participants. The participants have not yet seen the completed analysis.

Data Collection

One tape-recorded interview was conducted with each participant. The interviews were open ended and guided by the suggestions of Kvale (1996). The researcher let the interview process guide the questions rather than following a question guide. Each interview lasted until the interviewer and the participant sensed that the discussion and questions were exhausted. Each interview lasted approximately one hour. The interviews were fully transcribed and the analysis made from the transcriptions.

Data Analysis

The first author read through the transcribed interviews, took notes in the margin and underlined sentences or phrases that appeared to describe each participant's experiences. This process resembled the coarse coding described by Merriam (1998). During a second reading of the transcribed data, the first author began constructing three charts that displayed and summarized the categories of data. One chart (Figure A) displayed information describing the participants in their setting. The second chart (Figure B) displayed the similarities between the two participants. The third chart (Figure C) displayed the differences between each of the two participants' experiences.

As the first author created the charts, she also began to create a list of categories pulled from the transcriptions. This list was kept on a lined notepad beside the transcribed pages. This list of categories became the basis for analyzing, refining, and representing the data in ways that would meet the purpose of the study and answer the research questions. These categories were then re-analyzed and combined according to their supporting data units.

Self-disclosure of the researchers

The two researchers were drawn to designing a study to explore this issue because they have had personal experience with creating and teaching online courses for university students. Their personal experience facilitated their perception that a professor's experiences when designing and teaching an online course were different than the experiences when designing and teaching a similar face-to-face class. Because the two researchers are not tenured faculty, they became aware that the demands of the tenure process seem neither to reflect nor to recognize the differences between teaching in a face-to-face class and teaching in an online class. Thus, the two researchers had a personal interest in developing a research study that would identify and describe the contextual considerations new professors face when teaching an online course. The two researchers knew one another from being classmates in a Ph.D. program at the University of Georgia.

The Research Questions

- How do the professors describe the experience of planning and teaching an online course?
- How do the professors perceive the demands of teaching a class online compare with the demands of teaching a similar class face-to-face?
- How do the professors understand the context of online course development and teaching?

Representing the Data

The two professors

The two professors in this study, Professor Eden and Professor Simpson, teach at major universities in the United States. Professor Eden is teaching in a college of education at a Carnegie ranked Research I University; Professor Simpson is teaching in a college of hotel administration at a

doctoral granting university. Both professors are teaching required courses in their respective colleges. They are each using a well-known brand of online course software. During the period of this study, both professors were teaching online courses for the second time, and both were confronting the demands of the tenure process.

Both professors were technologically fluent in that they had created web pages for their courses prior to using the online course software, and both had originally started making pages by hand coding with HTML. Both professors valued active learning for their students and sought to use strategies that would facilitate meaningful knowledge construction. Although the professors did not use the term *learner-centered* to describe their approach to teaching and learning, they both described their concerns and teaching strategies in ways that meshed with Branch (1995) and McCombs and Whisler's (1997) description of learner-centered.

Professor	University	College	Course	Class Size	Students	Software
Eden	Primarily residential, Research Level I	College of Education	Educational Technology Required	15	Graduate In-service Teachers	Blackboard
Simpson	Urban, commuter campus, Doctoral granting	College of Hotel Administration	Human Resources Required	12	Undergraduate Working in hospitality	WebCT

Figure A. Chart displaying information describing the participants in their setting

The students in both classes were working in fields related to the course. Professor Eden's students were predominantly K-12 school teachers. Many were enrolled in the masters program because they wanted to advance to a higher pay level. Professor Simpson required the students to be working at least part time in the hospitality industry as a pre-requisite for enrolling in the class, and gave the students assignments that required the students to interact with the human resources personnel in that industry. The students in both professors' courses could choose to take the course online or in a face-to-face classroom environment.

Both professors wanted to be better at teaching. Professor Simpson stated,

> To get tenure you need to be able to teach at a standard that's acceptable to the university, and that standard is not acceptable to me. I needed to push myself to learn how to teach. So, I took a certification class, it's called a certified hospitality educator, which was a week long class.

<table>
<tr><th>Professor</th><th>Technology fluency</th><th>Online software</th><th>Teaching goals</th><th>Importance of feedback</th><th>Course development</th></tr>
<tr><td>Eden</td><td rowspan="2">Created their own resource rich web pages when teaching a prior class.</td><td rowspan="2">Had to spend time on their own to learn to use the university online courseware</td><td rowspan="2">Wanted to be better teachers than what their administrators suggested was acceptable</td><td rowspan="2">Believed students need good feedback in order to learn.</td><td rowspan="2">Learned about teaching online from the students' feedback, interactions and assignments.</td></tr>
<tr><td>Simpson</td></tr>
</table>

Figure B. Chart displaying similarities between the two participants

Both professors believed that their online courses had to be more than just reading and completing the assignments. Professor Eden explained,

> How are you really going to get them to think? . . . . I mean if all I had to do was pick up a book and read materials, then I guess universities are not really necessary . . . . So, I mean just

having a web site with your information on there, and having those discussion boards is not doing it. Because the discussion boards are hard to manage, people are not reading everything, and you're not really getting the interaction between the students that you want

Neither Professor Eden nor Professors Simpson had definitive answers to the challenges they were encountering as the developed their online courses. They were both actively learning as they went along. Both professors were learning from their students.

The two professors differed in some of the online software usage and in the ways they were encouraged to teach an online course. Professor Simpson was given release time from the department chair to develop the course. The professor considered online learning to be of growing importance to the hospitality field. The department let the class "go" even though its enrollment of 12 was less than the required number for running a course.

Professor Eden felt somewhat pushed into teaching an online course because the administration wanted to get more of the curriculum online. She was worried that the course would not be appropriate for online learning. "I didn't think the class was appropriate because it was team based, and I don't care if you do e-mail, you still want to meet face-to-face in a team kind of thing."

The two professor experienced differences in the way that their universities marketed the online classes. Professor Eden's university promotes online courses and online programs on the web site by appealing to people who don't have sufficient time to take a class. Professor Eden explained,

The way that it markets is probably the reason why we have the attitude problem of our students. The web site says, 'You don't have time to take a class? You don't have time for class?' So, what does that mean? . . . . Which means that you don't have time to do all the work that goes with the class, then take web based classes.

Eden	Advised to get the course up and it will run itself	Misleading marketing	Has used more than one course software	Teaches using team projects	Students reported confusion understanding organization of courseware interface
Simpson	Administration gave release time to develop course	Lack of informative marketing	Knows only WebCT	Teaches with individual projects	Students did not report interface confusion

Figure B. Chart displaying differences between the two participants' experiences

In contrast, Professor Simpson's university does very little marketing of the online courses and has no online programs. Professor Simpson attributes some of the class's low enrollment to a lack of marketing. "I don't know what distance ed said to them over there. The two flyers that I saw were not acceptable to me to find out information, and so I will be creating my own marketing this year for fall semester."

Because Professor Eden's students were taking courses at the university that were presented with different course software, and because part of their course included designing websites, they expressed their confusion about finding how professors' organized their online courses. "People organize information differently. So, I might put my assignment in *Assignments*. Some people put all their assignments in *Course Documents* . . . . Where do the students look for just this document to help them do something?"

Summary

Although the professors had many differences between their institutions and their fields of study, both professors shared a strong belief in active learning and learner-centered instruction. Both professors were motivated by a desire to create a positive and meaningful learning experience for their students. Both professors needed interaction and feedback from their students in order to gauge the

progress of their students' knowledge development. Both professors created projects or assignments in their online class to help their students learn and to enable the professors to understand how the students were progressing.

Findings in Response to the Research Questions

How do the professors describe the experience of planning and teaching an online course?

The two professors found their time management and preparation skills differ when they teach in an online environment. Both professors were learning to develop their online teaching and course development skills. The two professors discussed changes in their thinking as a result of developing and teaching online. Professor Simpson reported that the experience of both taking an online course and creating an online course caused her to think differently about learning. She explained, "I'll talk with my students about where do they learn best. And if they say, 'I learn the best curled up on my couch.' OK. Can you get you computer there?"

For Professor Eden, the online course caused her to rethink her frequency of online responses as it related to the students' ability to manage themselves..

The first time I taught, I tried to respond to every other message . . . . I started letting them control as far as like responding to each other. And I would add something in if I felt they were off target or getting out of hand, you know a little bickering and so forth . . . . But I felt I was taking up too much time trying to make sure they were doing what they needed to do.

How do the professors perceive the demands of teaching a class online compare with the demands of teaching a similar class face-to-face?

Both professors remarked about the different time expenditure between an online course and a face-to-face class. Professor Eden stated,

It's much more work than face-to-face. You definitely have to be more prepared, far more in advance. A lot of time when I was doing face-to-face I'd think, I want to change that a little bit because of the way they reacted maybe the week before and I could prepare the night before.

Professor Simpson was even more specific in the time differences.

I logged an average of six hours a week in WebCT in my class which is more than I ever put in on class time. . . . So, maybe four and a half hours max a week in a face-to-face class that I may teach two sections of versus six hours a week in an online course. And that's not counting the grading and inputting. I knew what it took to grade a project that I taught in a face-to-face class. That same project or some elements of the project to grade in an online class, write up the results, post the results, do follow-up, adds twice the amount of time.

How do the professors understand the context of online course development and teaching?

Both Professor Eden and Professors Simpson felt that the university administration did not have a realistic understanding of the time demands and demands for self-teaching that an online course required. Both professors had to spend time and energy figuring out the technology and the pedagogy of online teaching for themselves.

Both professors were strongly encouraged by their college administrators to use online course software although the quality of their support varied. Both professors knew that university administrators anticipated being able to teach larger classes with online technologies, and both professors expressed concern for the quality and course management of classes with larger enrollments than 25 or 30 students.

Teaching an online course forced the professors to confront the technology and the software. Professor Simpson designed elements into the course, such as audio clips or animated gifs, in order to check capability of the students' computers. "Throughout the course, I kept checking with the students to make sure they still had computers at home. And two students either lost their computers because they moved and it was the room mate's computer, or the computer failed on them."

Discussion of the Findings

Interaction

In the context of teaching their online courses, interaction became an important concept. Interaction infused both professors' thinking. The professors sought to create interactions on many levels. The interaction between the professors and the students and the course content and the students' work experiences and the technology was complex and was an important part of the professors' thinking about their online courses. The professors encouraged interaction between the students and the course content. The students in both professors classes were working in the field of study, and the two professors deliberately structured their courses in ways that would make the course content interact with the students' work life experiences.

The professor interacted with the students and learned from their students' interactions. Through the students' interaction, the professors learned how well the students were progressing in their knowledge development as well as how effective the technology and course organization was. In sum, the professors learned about how to create, organize, and teach their online courses from interactions with their students.

The Importance of the Students Expectations

The two professors' online teaching experiences were very influenced by the students' expectations. The students' expectations, as described by the two professors, were related to their reasons for taking the courses and the university's conceptualization of online learning as manifested through their outreach marketing. Professors Eden's students were primarily working K-12 teachers whose motivation for earning a graduate degree was to move into a higher pay grade level in their school systems. The university marketed the online learning program by implying that online learning was easier and required less time than coming to the campus to attend classes. The university's marketing efforts influenced the students' expectations that the course would make it easier for them to manage their time.

Tenure considerations

There were differences between the pressures the two professors experienced in regard to tenure documentation. Professor Simpson considered her field more applied than theoretical. Although there was pressure to achieve excellence in at least one of the categories, achieving excellence in the teaching category was sufficient to carry the lack of an excellence rating in the research category. However, this put even more pressure on ensuring a good rapport and evaluation from the students in the online course. Professor Eden faced greater pressure to publish and conduct research.

Implications and Recommendations

Implications for university administrators based upon the study

- Universities must provide more specific training support for professors using online technologies.
- Online courses are not a time saver for faculty.
- Universities must be critical about the way online courses are marketed to potential students

Recommendations for further study

The findings in this pilot study have served to illuminate the areas that need further data collection in order to design a more robust study.

- Further interviews and data needs to be collected to explain why the university administration is urging new professors to teach courses using online technologies.
- Further interviews and data need to be collected from more professors in order to exhaust all the questions that were raised in this pilot study
- A fuller search of the literature related to the context of online teaching needs to be developed.

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A COMPETITION TO PROMOTE THE DESIGN OF EDUCATIONAL SOFTWARE

Brad Hokanson
Simon Hooper
Paul Bernhardt
University of Minnesota

We established the University of Minnesota Learning Software Awards as a mechanism to identify and promote exemplary and innovative educational software. Our long-term goal is to establish an electronic forum featuring best practices in the field. We want to influence educational design by providing access to samples of work judged to be exceptional, and to create a form of eJournal that publishes active samples of exemplary practice-in-action, not simply written articles.

One criticism of our field is that we have not identified what we consider to be exemplary projects. Although many design professions have well established and easily accessible archives of their best work (e.g. art galleries, buildings, and books), the field of Instructional Technology has done little to establish resources where students or practicing designers can examine the best and most inspirational works.

During the fall of 1999 and spring of 2000, we solicited and received approximately 65 entries from across the United States. Judging involved a two-phase process. First, a pool of 35 judges screened entries. Twenty entries were forwarded for further consideration. Three expert judges conducted final judging: Tom Duffy (UNext), Lloyd Rieber (University of Georgia), and Stan Trollip (Capella University). The judges selected the following award winners and honorable mentions.

First place awards
The Writing Trek by Sunburst Communications
Math Problem Solving by Plato Education
Psychology Experiments by Kenneth McGraw, University of Mississippi
Off the Wall by Michael Gardner, University of Georgia

Runners-up
Research Assistant by Dan Schuch, Florida State University
Tuberculosis Case Management by University Research Co.

Honorable mentions
Claymation by Mary Beth Kiser, Edina Public Schools, MN
Probability Explorer by Hollylynne Stohl Drier, University of Virginia
Bohr's Atomic Model by Jeff Wilden, Weber State University

Although it was beyond the scope of the competition to provide full-access to the projects, all the winners provided resources that can be accessed and examined. Samples representing their projects are available at the competition website: http://design.umn.edu/learningcompetition In addition, each of the winners has submitted an article for a special issue of Tech Trends outlining the problems they addressed in their projects and commenting on how they designed their solutions.

Our primary goal was to support the development of innovative uses of technology. We focused on three dimensions of innovation for this competition. The first dimension involves using new capabilities of technology for educational advantage. For example, the very scale and accessibility of the Internet is used to the advantage of researchers and students alike through Psychology Experiments by Kenneth McGraw. There, the power of the Internet connects researchers and research subjects, and provides educational examples for study. Off the Wall by Michael Gardner uses the interactive capabilities of multimedia to investigate the artist Chuck Close. Users explore the work of the artist, interacting with elements of scale, brush stroke and subject. Jeff Wilden describes an interactive multimedia program titled Bohr's Atomic Model. This web-based interactive simulation allows students to build an atom using an atomic construction set.

The second dimension involves solving existing problems in a new or unusual way. Plato's Math Problem Solver and Sunburst's Writing Trek use unique capabilities of the computer and the Internet to assist learners while providing diverse and challenging learning environments. Plato's Math Problem Solving software uses real-world math problems and employs three levels of scaffolded support to guide the user through the solution process. Writing Trek includes a great variety of writing activities and provides the opportunity to publish student work on an Internet site. In contrast to these commercially developed products, Dan Schuch created Research Assistant, a database, to support the complex cognitive demands of graduate education. Not all winners were fully computer-based. Mary Beth Kiser's fifth grade class completed a learning activity involving clay, video, and the World Wide Web.

The third dimension includes new, under-addressed, or under-served problems. Tuberculosis Case Management by Elisa Knebel and Probability Explorer by Hollylynne Drier use the capabilities of the computer in this manner. Tuberculosis Case Management helps medical workers in the Third World, far from Silicon Valley, diagnose and treat a deadly disease. Probability Explorer is oriented to younger students. It engages children though probability experiments and exploration, and allows them to construct a more accurate understanding of the nature of chance.

Our observations from the competition provide insight into the development of educational software. First, it is clear from the descriptions presented by the award winners that the design processes employed varied greatly across the projects. Some groups followed formal methodologies, and in some cases, the strategies employed are the result of a formal design process. In other cases, however, the innovation appears centered on the overlap between expertise in the subject matter and a use or interest in a technology. Often, creative inspiration appears to occur as sudden insight.

Second, access to development funds did not limit creativity. As noted above, three winners were graduate students. Apparently, innovation does not require large teams or budgets. Third, comments from the competition judges about the value of the judging process were overwhelmingly positive. Many people commented that the process of reviewing competition entries was enlightening and worthwhile.

The competition was funded by the Design Institute at the University of Minnesota. The second round of the competition is currently being planned. Information about the competition, including a video and samples of this year's winning entries, can be accessed at the competition website.

THE PARADOX OF CONSTRUCTIVIST INSTRUCTION: A COMMUNICATIVE CONSTRUCTIVIST PERSPECTIVE

Rocci Luppicini
Concordia University

Abstract

With the advent of Constructivist oriented instruction in learning institutions comes an enormous challenge, that of structuring individual-centered learning within a community of learners. Within this instructional framework, struggles to satisfy both individual and group learning needs can lead to one canceling the other out. Tendencies towards either individual-centered or collaborative learning depend largely on the Constructivist stance adopted (Cunningham, 1991, Garrison, 1998; Jonassen, 1991, 1995; Lave & Wenger, 1991; Vygotsky, 1987). This ongoing struggle represents the paradox of Constructivist instruction; however, there is an alternative. This exploratory paper tilizes assumption from Internal Realism (Putnum, 1991, 1994) draws from advances in cybernetic science (Maturana & Varela, 1980; Varela, 1981) and communications theory (Habermas, 1990; Krippendorff,1994) to make the case that underlying biological and communicative structuring play an important constitutive role in multiple levels of meaning construction (biological, psychological, social) that are implicated in learning processes. The extent to which knowledge of underlying structures can inform on learning processes is addressed and recommendations are made for adopting Communicative Constructivist Perspective (CCP) as a potential educational reform tool for increasing awareness of instruction that may detract from efforts to achieve sustainable learning within a community of learners.

I. Assumption

This exploratory paper revolves around a conceptualization of the subject-object distinction held by a variation of realist philosophy that emphasizes the importance of human practices. This position is commonly referred to as 'internal realism.' Internal realists take into consideration scientific and everyday practices while utilizing subject-object conceptual distinctions to deal with conflicting knowledge claims in order to achieve rational consensus in a changing world (Putnam, 1994).

II. Defining subject-object conceptual distinctions

Why is it important to educational research and instructional design to address philosophical issues such as subjectivity and objectivity? Eisner & Peskin (1990) provide this answer: Thoughts have consequences: how we think about subjectivity and objectivity affects research procedure because these issues are typically embedded in the broader framework, abeit most often implicitly, that directs the conduct of our inquiry (p. 15).

Careful attention must be given when discussing the notion of objectivity and subject-object distinctions, since the terms can have strikingly different connotations depending on how they are being used and to what they refer. The subject-object distinction has ontological, epistemological, and methodological defining levels, along with relations between these defining levels. The ontological level deals with assumptions of what is known or knowable about reality and its nature. The epistemological level address the relationship between the knower and the known where assumptions concerning this relation depend largely on the ontological features supported. The methodological level deals with how one goes about finding things out, the process of which depends largely on ontological and epistemological features supported (Guba, 1990).

The internal realist position utilizes a specific formulation of the subject-object distinction which respect to the features at each level of the subject-object distinction described. First, in terms of ontology,

there is no truth claim to any absolute knowledge that subjects have of objects in the world as the Postpositivist/Realist position holds Instead, objectivity becomes a regulative ideal. Popper's (1968) states:

The status of truth in the objective sense , as correspondence to the facts and its role as a regulative principle, may be compared that of a mountain peak, which is permanently, or almost permanently, wrapped in clouds. The climber may not merely have difficulty getting there , because he may be unable to distinguish, in the clouds, between the main summit and some subsidiary peak. Yet this does not affect the objective existence of the summit. . .The very idea of error, or of doubt. . implies the idea of an objective truth, which we may fail to reach (p. 226).

Under Popper's reading of science, what is considered to be objectively true extends beyond what is empirically found and with it scientific inquiry entails more than compiling an inventory of cold hard empirical facts. This interpretation of the fundamental aims of science relocates the focus of objective truth from objective facts to a larger landscape of scientific inquiry more congruent with the extensive range of possible human experience under investigation.

This has an important consequence for education's use of scientific methodology. It suggests what we already know to be true, there is a lot more going on in the realm of experience at any given time than scientific inquiry is able to discern and that trying to maintain an awareness of the expansive landscape of experience leaves the door open to discovering new things in the study of learning processes that are continually immerging in lives. Closing the door on what is not immediately distinguishable is the mark of an impatient scientist

Second, in terms of epistemological features, the denial of the conceptual independence of subject and object is not a denial of the possibility of human subjects achieving true knowledge about what is objectively there in actuality. Putnam (1987) states, "Kant's glory in my eyes, is to say that the very fact that we cannot separate our own conceptual contribution from what is 'objectively there' is not a disaster." The fact that individuals' experiences take place in the world and within social/cultural communities does not in any way detract from the actual distinction that exists between the subject experiencing and the object experienced.

Third, in terms of methodological features, the individuals' within society constitute a community of critical inquirers. Popper expresses this well when describing the critical spirit of objectivity applied to science:

The objectivity of science is not a matter of the individual scientists but rather the social result of their mutual criticism, of the friendly-hostile division of labour among scientists, of their co-operation and also of their competition. For this reason, it depends in part, upon a number of social and political circumstances which criticism possible. (p. 95).

The subject-object conceptual position of the internal realist is to be distinguished from one commonly discussed within the area of Constructivist instruction. In the case of Constructivist instructional theory, most Constructivists accept only one subject-object distinction, that which is part of an epistemological belief system within the subject's experience . Constructivists generally oppose making the ontological subject-object distinction, interpreting this view as being part of an Objectivist stance, to be distinguished from an Constructivist view which does not commit to such a claim (Guba, 1990; Jonassen, 1991). To illustrate:

Table 1: Positions on subject-object conceptual distinctions

Domain	Postpositivism	Constructivism	Alternative
Ontology	Realist *	Relativist	Internal realist *
Epistemology	Objective *	Consensual/subjective *	Critical perspective *
Methodology	Verificatory	Hermeneutical reconstructive,	Rational Communication *

* upholds subject-object distinction

Upholding a commitment to ontological, epistemological, and methodological varieties of the object-subject distinction establishes a standard that Constructivist instructional theories have tended to conflate (Bopry, 1999; Cunningham, 1991; Cobb & Yackel, 1996; Jonassen, 1991).

III. What Constructivism in education is not

Constructivism is not a type of learning, nor is it a teaching methodology. It is not to be taken as some learning strategy that can be applied one day in a specific context and then forgotten. Rather, Constructivism can be categorized as a philosophy of learning that refers to how individuals learn all the time. That is, individuals constantly construct their learning, whether they are actively pursuing some form of discovery learning or sitting in a classroom taking notes.

However, there are different types of learning construction (Clemens, 1997; Devries & Zan, 1996; Johnson, 1998) for different levels of meaning construction (Bunge; 1979, Gabora, 1997, Luhman, 1986). Some learning processes will be more individually centered and some more group oriented. In addition, not all learning processes will occur at the same level of individual awareness or self-consciousness (Damasio, 1999; Dennett, 1991). There is no one way that has succeeded in explaining the many types of learning constructions adequate to provide a comprehensive picture the Constructivist learning taking place.

IV. Statement of problem

It is argued that the conflation of the ontological subject-object conceptual distinction has narrowed the range of what the epistemological and methodological subject-object conceptual distinctions refers. It is this narrowing of the range of inquiry that is believed responsible for conflicts in how instructional designers conceptualize group and individual oriented instruction , giving rise to an ongoing struggle referred to here as the paradox of Constructivist instruction.

V. Objectives

The paper draws on contemporary work in neuroscience, cybernetics, communications theory, and philosophy of science in order to develop a Communicative Constructivist Perspective (CCP) within a framework that suggests the complementarity and parellel duality (independent yet integrated) of Constructivist learning processes and knowledge.

VI. Constructivist learning processes

One way to view the Constructivist learning is to describe it in terms of processes that make it up and that vary in level of conscious awareness. This is an important component of Constructivist instruction in that research on learning processes informs on instructional design. What is striking in the Constructivist literature is how different the range of explanations for learning processes can be as a function of the Constructivist position held.

i. Meta-cognitive, cognitive, motivational and affective processes

Breadth and depth of self-system processes are demonstrated in basic psychological processes identified in cognitive psychology. Meta-cognition refers to the monitoring and controlling of cognition (Zimmerman, Bandura, Martinez-Pons, 1992). This is typically differentiated from regular cognitive processes. Cognitive processes refer to those mental operations required to encode and retrieve information. Wolters (1998) views cognitive processes as goal oriented, strategic, and attentional. Motivational processes refer to the underlying drive or desire towards something. Motivational processes are associated with the directing of effort towards some goal, either intrinsically or extrinsically determined. Affective processes are distinguished from cognitive, meta-cognitive, and motivational processes. Affect has been used to refer to feeling states, moods, and emotional experiences (Newman, 1994).

In contrast to motivational states, affective processes often tend to be more diffuse and sometimes without any specific direction or focus. The diffuseness of certain psychological processes (i.e., feeling, emotion) have made it difficult for cognitive psychology to explain. This is due to the fact that affective processes are largely co-determined processes within the self-system independent of self-consciousness, making these processes difficult for individuals to grasp.

ii. Individual Constructivism and volitional processes

Different views on how to treat intentional and collaborative learning have Views of the self (I) as a substantive category began with the Cartesian theory (Descartes, 1641). While the view was greatly criticized throughout modern philosophy, substantive notions of the self continue to flourish. McCombs & Marzano (1990) view the personal self-structure as the generative structure for self-processes. They state, "To generate the will for self-regulation, students must realize that they are creative agents, responsible for and capable of achieving self-development and self-determination goals, and they must appreciate and understand their capabilities for reaching these goals." This gets at the importance of individual 'self-directedness' quality of learning.

Von Glaserfeld (1995) labels volitional processes as an individual's 'mapping of actions and conceptual operations that had proven viable in the subject's experience. Deci, Ryan, & Koestner's (1999) theory of self-determination is concerned with the degree to which individuals experience their mental processes to be freely chosen rather than being coerced by desired outcomes. They distinguish self-determination from external determination by the extent to which individuals believe they have causal control. At this level, self-determining processes are connected to the concept of "self." Such processes take place at the level of self-consciousness, but there are other processes that cannot be explained within the framework of the "self" concept. This is the case for different levels of processes where self-consciousness does not accompany the processes taking place.

iii. Social Constructivism and social processes

Social processes have also been implicated in the determination of constructivist learning. Much of the work in this area is referred to as social Constructivism, drawing its main theoretical basis from Vygotsky (1987), social activity theorists (Bordieu, 1976; Garrison, 1998; Lave & Wenger, 1991), and pragmatism (Rorty, 1978; Putnam, 1987). Garrison's (1996), approach emphasizes individual's self-realization being derived from actions in the social world. Social processes are largely embedded in a social context characterized by argument, discussion and debate.

Hare (1983) supports the position that individual processes are social in origin and create the various unities of personal identity (sense of personal identity, self-consciousness, agency). The ability to conceive of oneself as a unique singular being is a necessary precondition for the acquisition of a theory of self, experienced as one's sense of identity. Self-consciousness involves both knowing what one is experiencing (consciousness) and that one is experiencing it, which involves the capacity (concept of theoretical self) to be able to make some form of self-reference. Under this view the primary human reality of social processes is taken to be persons in conversation. Hare (1983) states, "The psychological secondary structure is a reflection of the primary structure, the array of persons and their conversation which is the primary reality of the society which brings them into being."

VII. Constructivist learning knowledge

Constructivist learning can also be described in terms of the knowledge structures and capacities attributed to it. Goldstein (1986) refers to knowledge as 'an organized body of knowledge usually of a factual or procedural nature, which, if applied makes adequate job performance possible.'

In this discussion on Constructivist Instruction, knowledge is used to refer to the mental facts, procedures, and strategies individuals rely on when making judgements and carrying out actions. This is to be distinguished from learning processes that refers to how individuals acquire knowledge and skills (Gordan, 1994). This distinction is important for two reasons. First, it maintains the dichotomizing strategy used throughout the paper. Knowledge is an object acquired by subjects through learning processes. Second, distinguishing knowledge from learning processes can allow for advances in understanding. Gordan (1994) states, 'By understanding something about the basic types of knowledge that

experts and novices use in performing tasks, we can enhance the processes involved in front end analysis, instructional system design , and program evaluation.'

Research studying the nature of knowledge and how it is acquired has given rise to various taxonomies being used to provide grounding for instructional program designs (Anderson, 1983; Gagne, 1985; Rasmussen, 1986). The taxonomy employed in this exploratory piece deals with the two types of knowledge traditionally associated with the notions of objectivity and use of subject-object conceptual distinctions, These are scientific knowledge and universal knowledge.

i. Universal knowledge

Rationalist philosophy has provided initial support for viewing human beings as possessing universal knowledge . Spinoza (1677) stated," Human reason begins in the same reason with its native powers and thus creates its first intellectual tools." Similarly, Piaget's (1954) cognitive development approach posited universal structures of knowledge (e.g. pre logical, concrete, abstract) or general categories that evolved with the biological organism (genetic epistemology).

Discourse on universal knowledge is not limited to individual rational principles but also includes communicative principles which govern all communicative exchange. Habermas'(1989)communicative approach to universal knowledge maintains its individual appeal to rationality while being at the same time deeply related to communicative exchange and has the potential to offer much to educational researchers interested in the theoretical bases of the relation between individual and social learning.

Habermas' Discourse Ethics (1989) seeks to imbed communicative knowledge within a dialectical framework, which acts as the moral determinate. He accomplishes this by treating human consciousness as that which is structured by language exchange within a normative structure of social interactions. Habermas' modified version of universal morality can be characterized by the following features:

1) Habermas advocates a communicative theory of meaning where validity and truth claims are decided by resolving normative rightness, which can be determined through discursive argumentation.

2) Habermas (1990), summarizes the generalized imperative that corresponds to his theory of argumentative discourse. He states, "All affected can accept the consequences and the side effects its general observance can be anticipated to have for the satisfaction of everyone's interests (and these consequences are preferred to those of known alternatives possibilities for regulation)."

3) The justification of Habermas' universal morality lies in accepting universality as a procedural principal of practical discourse. Habermas' notion of universality ('U') requires that each individual adopts the perspective of all others that are affected by the consequences of argumentative discourse. The types of questions that can be treated in such a manner are those that concern rightness and just regulation of social interactions involving all persons.

For Habermas, moral practices are social matters to be decided by discourse interactions of individually deliberating subjects. Thus, both individual will and community practices are taken into consideration by Habermas' universal theory of argumentative discourse. Habermas supports the causal role of socialization in shaping personal identity as well as the capacity of discourse to represent this.

ii. Scientific knowledge

The assumption at the beginning of this paper attributed to scientific inquiry the notion of objectivity construed as a regulative principle under the Internal Realist stance. Now the question becomes,what is the nature of scientific knowledge within the philosophical framework of Internal Realism? The following answer is provided.

At the level of basic neurophysiological organization there is multiplicity in function. The human brain and its respective components that underlie all cognitive function are not simply limited to specific functions. Edelman (1989) states, "There is no unique structure of combination of groups responsible to a given category or pattern of output. Instead, more than one combination of neuronal groups can yield a particular output , and a given single group can participate in more than one kind of signaling function." Even at the most rudimentary level of the human biological organisms, it is recognized that there is an interactive learning process taking place where some neuronal pathways are stimulated and strengthened with ongoing stimulation, whereas others are not. Dennett (1991) refers to this as the plasticity in nervous systems. This multi-function capacity could be used to help explain intercultural and interpersonal

differences reflected in individuals' learning styles with respect to the various backgrounds from which they evolve.

In addition to multi-functioning capacities,scientific knowledgehas been attributed a multi-perspective quality. Science-based knowledge is useful in providing leverage for multiple perspective explanations. Bohr's "complementarity theory" involves particles and waves while Aschby's "Law of Requisite Variety" provide strong support for the complementarity of multiple perspectives (Boyd & Zeman, 1995). The popularity of the Kuhnian notion of "paradigms" in historical scientific inquiry and recent scientific work attest to the recognition of multiple perspectives (Horwich, 1993). Assumptions of complementarity of perspectives pull together evolutionary, genetic, and rational perspectives on universal knowledge. This is an alternative to extreme positions which support either: 1) there being only one accurate description of reality possible (Scientific Realism) or, 2) there being no accurate description of reality possible (Postmodernism). This could prove useful in promoting interdisciplinary approaches to learning with a critical orientation.

Scientific knowledge informs on Constructivist instructional theory in multiple ways. First, knowledge gained from neurological research informs on how the brain structures work , how they develop, and how they can be changed (Edelman, 1992). This contributes by providing information concerning how the mind functions. Edelman (1992) states,"A description of mind cannot proceed liberally-that is, in the absence of a detailed biological description of the brain." It is a limitation that cognitive science has traditionally adopted a functionalist position defining the mind as being made up of mental representations that operate according to a set of definite procedures or computational functions that can be studied independently of underlying structure.

VIII. The struggle for a framework to accommodate Constructivist learning processes and knowledge

In order for a more complete grasp of learning to be achieved, there has to be some way to make intelligible all relevant knowledge structures and mental processes that constitute it. Markus & Wurf, (1987) insist on the need for the integration of the

complex set of intrapersonal (affect, cognition, motivation) and interpersonal (social perceptions, feedback from others) processes.

Efforts to describe learning processes involved in accessing knowledge have

resulted in the positing of various descriptions of mental processes and mental models. Johnson-Laird (1983) states, 'Mental models enable individuals to make inferences and predictions, to understand phenomena, to decide what action to take and to control its execution, and above all, to experience events by proxy (p. 397).' Understanding the relationship between knowledge taxonomies and corresponding mental models is a central part of instructional program design and its description. Therefore, the use of information technologies and communication theory in the following discussion addresses both functional and structural aspects.

Insights from neurological research recommend greater attention be paid to human functions that have been difficult to address by concentrating on psychological

processes alone (i.e., affect). Demonstrating the breadth and depth of processes requires a set of knowledge tools to get at those processes that fall beyond methodological approaches employed in cognitive psychology . Damasio (1998) supports there being both a biologically 'core consciousness' that is relatively stable across one's lifetime as well as an 'extended consciousness' with many levels and grades that produce an elaborate sense of self through lifelong individual processes. In this way, what counts as constructivist learning can be seen to extend beyond what individuals are consciously aware.

i. Contributions from Cybernetics

A recent turn in Constructivist instruction to the Cybernetic science offers new insights for instructional designers. Basic Cybernetic systems are organizing systems, operating by feedback mechanisms mediating from system outputs to subsequent system inputs. Bopry (1999) supports that this turn has the potential to provide Constructivist practitioners a 'philosophical mooring within the field itself.' Developments in this field have yielded numerous models of autonomous systems functions used to describe the operation of living and non-living systems (Varela, 1981). Basic autonomous systems can be characterized by four fundamental features: 1) organizational closure, 2) structural determination, 3) structural coupling, 4) proscriptive development.

Organizational closure refers to the organizing of the defining relations of a system necessary for the system to exist. Varela (1981) states "Organizational closure arises through the circular concatenation of processes to constitute an interdependent network." Without organizational closure, autonomous systems could not exist. In the game of chess, were it not that each chess piece had its respective operations on the chessboard, chess could not exist. Structural determination refers to the internal dynamics of autonomous systems responsible for structural change. Autonomous systems are limited by the interactions that its structure makes possible. Humans do not have the necessary wing structure to fly as do birds. However, human structural determination does allow for walking. Structural coupling refers to the interactions that autonomous systems have with the environment. Bopry (1999) states, "When a unity is in continuous interaction with the environment, so there is a mutual triggering of structural change over time that is stable in nature, the unity and the environment are said to be structurally coupled." Maturana & Varela (1987) support that structural coupling represents the basis for higher order cognitive development. Proscriptive development describes how it is that nature constrains living organisms during the process of evolutionary change. Varela (1991) states, "In a proscriptive context natural selection can be said to operate, but in a modified sense: selection discards what is not compatible with survival and reproduction."

Proscriptive functions are not limited to explanations of biological evolution. Bopry (1999) connects proscriptive development with culture and language use. Bunge's (1977) emergent level cybernetic theory and Boyd's (1993) cybersystemic theory provide explanations for multiple levels of emergent processes that include neurophysiological, autobiographical, and psycho-social processes.

Damasio's (1998) linking of conscious processes to neural architecture supports a general anatomy of consciousness.

Cybernetic's attention to the role of structure and organization in structural change runs concurrent with the underlying assumptions of this paper pertaining to subject-object conceptual distinctions. The subject-object conceptual distinction reappropriated as a Cybernetic structural-organizational conceptual distinction is supported by views of the commensurability of universal and scientific knowledge.

From an evolutionary perspective, a universal drive for self-preservation is recognized that binds individuals together in communicative collectives (Gould, 1986; Dawkins, 1973). Evolutionary theory supports the universal human drive to create (propagate) one's self (Darwin, 1871), one's genes (Dawkins, 1976), or one's mental representations or 'memes' (Blackmore, 1999). Cybernetics and evolution theory provide support for viewing human beings as possessing universal knowledge tools (Blackmore, 1999; Boyd & Zeman, 1993).

To take this one step further, Boyd (1993) supports the aesthetic critique as a universal knowledge tool. Advancements in aesthetic education have their biological origins in early attractiveness/repulsiveness experiences with the world. This basic level of biologically evolved perceptual engagement forms the basis of what later may develop into personalized and socialized preferences. Gabora (1997) supports that, in line with evolutionary theory, mental representations (or memes) evolve through adaptive exploration and transmission of information by way of variation and selection. This can be employed to explain the evolution of culture and creativity. Boyd & Zeman's (1993) notion of "generative concepts" is treated as a set of actively developing tools that function on a meta-level as principles for conceptual organization.

Cybernetics has the potential to make two important contributions to Constructivist Instrional theory. First, it gets at a depth of Constructivist learning that has been neglected in contemporary instructional design theory. This can be used to provide a basis for inquiry into a greater range of learning processes than has been considered in instructional theory. Second, there is also an important recognition of the genetic epistemological structures that have a causal role within the complex set of learning processes that instructional designers are interested in. The potential for the inclusion of science is quite attractive for instructional theories like Constructivist that do not provide obvious "self-correcting" mechanisms for interventions designed.

ii. Recursive communication

Krippendorff (1994) advances a recursive theory of communication based on assumptions of the self-referential quality of human communication. This approach to human communication focuses on the process of communicating as well as what is communicated. It puts forth the following propositions:

1) Human communication theory must also be about itself.

2) Everything said is communicated to someone understanding it as such.

3) Human communication constitutes itself in the recursive unfolding of communication constructions, held by participants (including of each other), into intertwining practices that these participants can recognize and explain in terms of being in communication.

This approach to human communication contains two defining features that are crucial to Constructivist Instructional design. First, it acknowledges self-referential quality of experience. Asserting that communication theory is about itself is to recognize that individuals experiences (even acts of theorizing about communication) are not products of the outside world but rather, are constructed from within the realm of one's own experiences. Krippendorff (1995) states,'Whatever gives rise to the awareness of something being said and communicated, the causes of ones experiences, must be located within one's horizon od understanding.' As such, individuals are responsible for constructing their own communication and the communication of others

Second, it recognizes the recursiveness of human experience. Individuals monitor their communications, transforming the consequences of actions into information that revises knowledge used to direct future actions. It maintains the necessary positioning of oneself within communications which includes other human beings and to attempt to understand others perspectives.

Together, Cybernetics and Recursive Communication Theory represent innovative approaches for the linking of Constructivist learning processes and knowledge under a complementary dualistic framework. Instead of conflating object-subject distinctions, this view suggests that it is possible to make

connections between complementary knowledge/structures and processes/functions that advance understanding. To illustrate:

Table 2: A complementary framework for Constructivist learning processes and knowledge
Constructivist Learning Processes

Constructivist Learning	Processes -Knowledge	Constructivist Learning Knowledge
Individual Constructivism	Cybernetics	Scientific Knowledge
Social Constructivism	Recursive Communication	Universal Communicative Knowledge

The Communicative Constructivist Perspective (CCP) presented next takes the resolution of the Paradox of Constructivist instruction to be its primary focus. It does so largely by drawing together the theoretical strands discussed thus far.

IX. Communicative Constructivist Perspective (CCP): A multi-level, multi-perspective account

CCP is proposed to describe the breadth and depth of Constructivist learning experienced by individuals living within a community of learners. The first fundamental criterion concerns the importance of viewing meaning construction from multiple perspectives (aspects) and sharing these perspectives in such a way as to shape individual and collaborative learning. This gets at the need for both individual expression and collaborative communication where individual expressions occur and develop within individuals' sharing of subjective experiences.

In practical terms, students' learning experiences do not take place in isolation. Learning involves all individuals who partake in the ongoing communication and decision making together. This minimally includes, learners, parents, teachers, and administration coming together to express views in ongoing discussions.

The second fundamental criterion of CCP concerns employing definition of Constructivism that is broad enough to capture the multiplicity of knowledge structures (Boyd & Zeman, 1993; Cobb & Yackel, 1996; Edelman, 1989; Hare, 1983) at the various levels of meaning production (biological , psychological, social) that influence learning experiences. CCP addresses structural knowledge and self-systems processes that have been identified both outside and within Constructivist, Situated-Cognition, and Self-regulated learning literatures (Cobb, 1994; Yang, 1993; Zimmerman, Bandura, & Martinez-Pons, 1992).

In practical terms, learning is assumed to be multi-perspectual and therefore, requires flexible multi-level knowledge to be accommodated within higher-order learning activities in order to explain its complex nature within a community of learners. This is essential in interdisciplinary programs of educational instruction where students are exposed to a diverse range of educational content.

When designing education, it is important to recognize that what constitutes individual learners extends beyond psycho-social processes and our sense of self. In order to develop individual and collaborative learning, efforts should be directed at both the learner and the learning environment. For this reason, educational design requires theoretically grounded proscriptive and prescriptive necessary conditions. Utilizing a CCP for the purpose of educational design could result in adopting the following orientation:

Table 3: Key Postulates of the CCP Perspective

CCP Postulates	Description
Critical Orientation.	Not all subjectively constructed meaning will be equally accurate and it is an asset to be able to critically evaluate learning constructions.
Process and Identity Orientation.	Because this real world is subjectively experienced by each individual within a social realm, there is a dual need to develop one's own learning processes and personal/social identity.
Multiple-Perspectives	Many viewpoints or perspectives contribute to a more complete understanding which more closely approaches the truth.

Communicative Orientations	Constructivist learning often involves students, parents, teachers, and all other stakeholders.

This draws together much of the Constructivist learning mentioned already in an effort to apply it to individually meaningful collaborative learning process. Some of postulates (i.e., authentic and collaborative learning, decision making, communication skills development, etc.).

The CCP general orientation outlined could contribute to education applied to the design of interventions in order to modify the structuring and content of instruction in an effort to raise individuals' awareness of humans complex organisms amongst other complex organisms interconnected at various levels within the learning environment.

X. Educational and scientific contribution

Overall the notion of objectivity assumed to be a regulative principle was supported by efforts throughout the paper to demonstrate the complementarity of Constructivist Instruction informed by science and communicative theory.

First, it could offer a causal account of learning. Causal explanations are well suited for explaining general measures of student functioning such as attitude and achievement (Zimmerman, 1986). There are very few causal explanations to be found in Constructivist or self-regulated learning literatures (McCombs & McCombs, 1990). Causal accounts have an explanatory value that could provide a great contribution to the Constructivist literature if fully developed.

Second, it could act as a multi-level explanation, addressing learning at multiple levels where it occurs (physiological, psychological, social). This is an emergent-level perspective in that there are simultaneous levels of learning emerging at the same time with their own respective properties (Bunge, 1979). However, it is also a causal explanation, maintaining the subject-object separation that other accounts (i.e., symbolic interactionism) do not uphold.

Third, CCP could be used as a multi-function explanation, concerned with the necessary flexibility of learning (i.e., learner style, self-efficacy, intention, etc.). It could also include consideration of contextual functioning (i.e., meta-cognitive and cognitive strategic planning, goal-orientation, learner control, etc.).

Fourth, it could be used to uphold the distinction between knowledge structures and processes that underlie individuals' psychological processes and abilities to be self-determined learners within a community of learners. Being able to attend to both knowledge and processes is considered essential to achieving a more complete grasp of Constructivist learning. The strategic integration of these elements offers a philosophical 'mooring' for Constructivist Instructional Theory and Practice .

An objective communicative set of procedures can also address standards of evaluation required for effective instruction. The contribution to be made lies in how it is that standardized evaluative measures essential to instruction are treated. Under this view, problems of evaluation are resolved by Constructivist instructions' prescriptive function. First, evaluations would not simply be administered but would be integrated as part of the learning process. This can be accomplished by making clear who is responsible for creating the evaluative standards and when. This way students can feel they are not merely subjected to some imposed standard, but rather are participating in the standard evaluation. This is done so that students can learn to understand the standard as a first step in being able to participate in the evaluation and selection of future standards. This can be taken to be a type of cognitive apprenticeship (Clancy, 1992; Cobb, 1996; Collins,1991).

Second, learners are participating in standard evaluations administered not with the understanding that the standard is true but rather, is a logical possibility, objectively true for all learning participants and to be worked towards in a cooperative manner (Habermas, 1995; Kagan, 1990). This captures the essence of what Constructivism should encourage when attempting to provide instruction in an educational setting.

Conclusion

The multi-level CCP offered an alternative to the paradox of Constructivist instruction by focusing on recent developments in Cybernetics and communicative theory to get at a depth of

Constructivist learning neglected in contemporary instructional design theory. Support was given to demonstrate that what affects each of us as learners extends beyond our psycho-social processes. The present discussion focused on these underlying elements of learning in demonstrating their potential implications for the development of learning interventions.

Future work will be directed at developing educational interventions that raise the general awareness of the complex set of learning processes and knowledge that arise from individual and collaborate Constructivist instruction. This could be beneficial in promoting self aware and socially responsible learning.

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USING SMIL TO CREATE A WEB-BASED MULTIMEDIA VIRTUAL LIBRARY TOUR

Yuwu Song
Arizona State University

Abstract:

This article shows how to use SMIL to create an Online Multimedia Virtual Library Tour. The presentation is composed of a slide show of text and still images, which introduces the library. It is accompanied by background audio and a caption. In this presentation there are hyper-links to related library web sites.

URL: http://www.asu.edu/lib/webcom/yuwu/VisualTour/visualtour.smil
To view this file, you need a RealPlayer plug-in which can be downloaded free from: http://www.real.com.

The Virtual Library Tour presentation is created by using Synchronized Multimedia Integration Language (SMIL). SMIL as a new web format allows us to put text, still photos, audio, video, and animation into interactive presentations. The World Wide Web Consortium on June 15, 1998 (www.w3.org/tr/rec-smil) published the specification which defines SMIL as an application of XML. The specification depicts the design layout and temporal behavior of multimedia presentations.

With SMIL, you can produce interactive multimedia presentations of broadcast quality. You can provide links within a presentation that access other presentations, other media files, or web sites. Before the streaming technology came into being, multimedia files such as MPEG video or AIFF audio had to be downloaded completely before we could see them play. Streaming technology allows multimedia servers send a file in a continuous stream that can be played back shortly after the local machine get parts of the files. It would take a few minutes for a traditional video file to be downloaded while for a streaming video, it only takes a few seconds before you can view it.

To create, publish, and broadcast SMIL presentations, all you need is a PC and access to a compatible server. To see SMIL in action, you need a compatible player such as RealPlayer G2 (free, downloadable from http://www.real.com.) Once you download and install the player, you can view SMIL presentations. You can also access SMIL presentations from the Web. When you do this, your browser launches the SMIL player, which in turn displays the presentation.

Like HTML, SMIL is a subset of XML, and because XML is defined using text markup tags, you could make the layout and design of SMIL presentations using a regular text editor such as NotePad.

SMIL's media object tags allow you to put various media types in your presentations, and they are self-explanatory. The <audio> tag supports audio files such as AIFF. The <video> tag supports video formats such as RM files . The <img> tag is for still images such as JPEG files or RealPix. The <text> tag is for static text files; the <text src> or <textstream> tag is for streaming text files such as RealText. You can mix any of the available media types in your presentations.

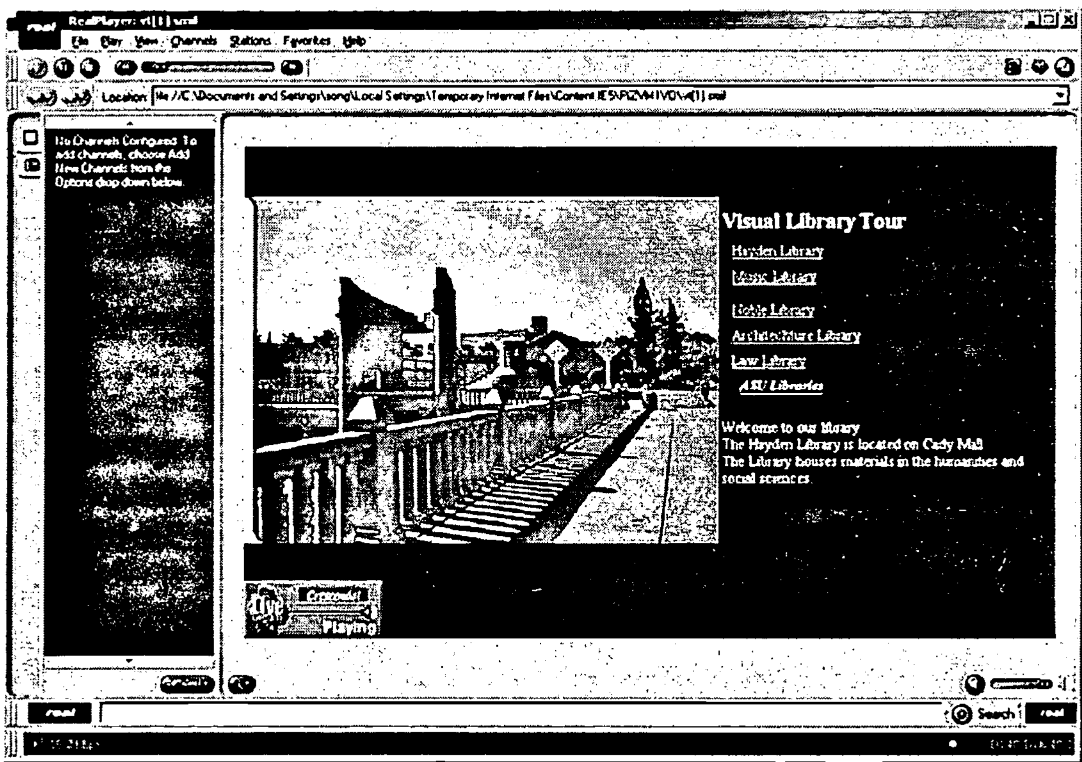
The presentation layout determines how you set up your screen. SMIL players have a window. When you want to play multiple media types simultaneously, you need to create regions or mini-windows within the main window.

Regions are like cells within a HTML table. You can decide the size and position of the window as well as the size and position of the mini-windows within it. The root-layout sets the height and width of the entire presentation in pixels. This is the whole player area, which will be divided into regions. Each region sets specific areas in the presentation that media will play in.

```
<layout>
    <root-layout height="405" width="770" background-color="black"/>
    <region id="title" left="5" top="120" width="400" height="200" z index="1"/>
```

```
    <region id="full" left="0"  top="0" height="425"  width="450"
     background-color="#602030"/>
    <region id="video" left="450" top="240" height="120" width="315" z-index="1"/>
    <region id="toc" left="450" top="0" height="405" width="255"/>
</layout>
```

First we size the main window (identified with the <root-layout>tag) to 405 by 770 pixels and then create 4 mini-windows within the main window: title, full, video, and toc. The title region is positioned 5 pixels to the right of the main viewing area's left edge and 120 pixels down from the top of the main viewing area. The other regions are placed according to their respective pixels. By defining layout regions, you can combine multiple forms of media and display them simultaneously. The following picture will show you how the interface looks like.



Let's take a look at how SMIL combine media files and make them play. The following code shows an example of event timing:

```
<par>
        <audio src=http://www.asu.edu/lib/webcom/yuwu/VisualTour/smone2.rmi
         dur="400s"/>
        <text src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/toc.rt" region=toc"/>
        <text src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/song.rt"    region="video"/>
        <seq>

<!-- This part displays the title screen and the caption with an audio soundtrack-->

        <text src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/title.rt"
        type="text/html" region="title" dur="35s"/>
```

```
<!-- This section displays a slide show -->

<par>

     <img src=http://www.asu.edu/lib/webcom/yuwu/VisualTour/map.rp
       region="full" fill="freeze"/>

</par>

<!-- This section contains the annotated slideshow -->

<par>
     <switch>
     <img src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/slideshow.rp"
       region="full" fill="freeze" system-bitrate="45000"/>
      </switch>
</par>
</seq>
</par>
```

SMIL offers two ways to play media elements: sequentially (one file right after another in a single region), where a few files: text, audio, or video files can play at the same time. Each line between the <par></par> tags is a media file which will play to a specified region. The <par> tags mean that media files will play simultaneously (in parallel). The <seq> </seq>tags mean that they will play sequentially. Fill="freeze" means that the final frame will stay visible when that media file is done.

When the presentation starts, the text file toc.rt displays. The audio clip smone2.rmi also begins. Then the text file title.rt clip specified in the next line starts at 35' into the presentation. Then the slide show begins. While the audio clip is playing, the text and slide show are displayed. By adding a time line to a presentation, you can control when content is displayed and how transitions between various content types are handled. SMIL provides sophisticated control the protocol offers.

One feature of SMIL is that by setting choices, you can even serve up different versions of the production based on the available bandwidth. In other words, you can use the <switch> tag to get the player to use media files appropriate to the bandwidth.

```
<switch>
     <img src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/slideshow.rp"
       region="full" fill="freeze" system-bitrate="45000"/>
</switch>
```

The presentation's bandwidth needs are optimized based on the speed of your computer's connection to Internet. The media files used in the presentation will depend on whether you have a 28.8 modem or a high-speed connection such as a T1 line. This feature makes it possible that users enjoy the presentation regardless of their connection speed. You can include low- and high-bandwidth choices. The <switch> tag tells the player it should make a choice. The bandwidth choices are made in the order listed, the highest-bandwidth choice should come first.

One of the greatest advantages of SMIL is synchronization. SMIL offers quite a few features for handling the timing of media playback. One can set specifically a duration for a media clip. For example, you can assume that the file will play for 3 minutes. You can time events according to the time line for the entire presentation. You can let a media file begin 10 seconds into the presentation and end 15 seconds into

the presentation. You can decide what should take place at the end of the presentation. For instance, you can remove all graphics or video clips from the display or you can freeze still images on the last frame.

You can use special effects like fadein, crossfade, viewchange, and wipe target in your slideshow presentation. For each special effect, attributes such as start specify the time to begin, duration how long the picture lasts, and target the source of the picture. For example: <crossfade start="00:45" duration="00:08" target="5"/>.

You'll likely be using a lot of file formats when you create your multimedia production. Keep in mind, you should transfer all standard animation, video, and audio file formats to streaming formats, such as RealFlash, RealVideo, and RealAudio.

When you complete presentation, you should move the multimedia files and the SMIL file to the web server. The server should be configured to handle multiple forms of media including text, audio, video, and animation, and they should understand hypertext links. If the server supports all the media formats such as ra, rt, rm, rp, smil, etc., you can view the presentation in your SMIL player such as RealPlayer G2, GRiNS (GRaphical iNterface to SMIL), or HPAS (Hypermedia Presentation and Authoring System).

Appendix: Source Codes for the Virtual Library Tour:

You can create your own presentation by customizing the following codes, that is, changing the variables and replacing text, audio, graphic files with your own.

1. vt.smil code:

```
<smil>
  <head>
    <layout>
      <root-layout height="405" width="770" background-color="black"/>
       <region id="title" left="5" top="120" width="400" height="200" z-index="1"/>
       <region id="full" left="0"  top="0" height="425"  width="450" background color="#602030"/>
      <region id="video" left="450" top="240" height="120" width="315" z-index="1"/>
      <region id="toc" left="450" top="0" height="405" width="255"/>
    </layout>
  </head>
  <body>
   <par>
        <audio src=http://www.asu.edu/lib/webcom/yuwu/VisualTour/smone2.rmi
         dur="400s"/>
        <text src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/toc.rt" region=toc"/>
        <text src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/song.rt"   region="video"/>
        <seq>

<!-- This part displays the title screen and the caption with an audio soundtrack-->

        <text src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/title.rt"
        type="text/html" region="title" dur="35s"/>

<!-- This section displays a slide show  -->

<par>

      <img src=http://www.asu.edu/lib/webcom/yuwu/VisualTour/map.rp
        region="full" fill="freeze"/>
```

```
</par>

<!-- This section contains the annotated slideshow -->

<par>
        <switch>
        <img src="http://www.asu.edu/lib/webcom/yuwu/VisualTour/slideshow.rp"
           region="full" fill="freeze" system-bitrate="45000"/>
         </switch>
</par>
     </seq>
       </par>
           </body>
</smil>
```

2. toc.rt code (for the table of content):

```
<window type=generic duration="6:30.0" scrollrate=0 height=250 width=375 bgcolor="#000000"
link="#DDBBBB" loop=true>

<time begin ="00:02"/><font size="5" color="white" face="times"><pos y="10"/>
<br>
<br>
<br>
<b>Visual Library Tour</b>
<br>

<time begin="00:05"/>

<font size="3" color="white" face="times">
<a href="http://www.asu.edu/lib/hayden/">Hayden Library</a></font>
<br>

<time begin="00:07"/>
<font size="3" color="white" face="times">
<a href="http://www.asu.edu/lib/music">Music Library</a></font>
<br>

<time begin="00:9"/>
<font size="3" color="white" face="times">
<a href="http://www.asu.edu/lib/noble/">Noble Library</a></font>
<br/>

<time begin="00:11"/>
<font size="3" color="white" face="times">
<a href="http://www.asu.edu/caed/AEDlibrary/">Architechture Library</a></font>
<br/>

<time begin="00:13"/>
<font size="3" color="white" face="times">
<a href="http://www.lawlib.asu.edu/">Law Library</a></font>
<br/>
```

```
<time begin="00:15"/>
<font size="3" color="white" face="times">
<a href="http://www.asu.edu/lib/"><i><b>ASU Libraries</b></i></a> </font>

</window>
```

3. title.rt code (for the title):

```
<window type="generic" bgcolor="#602030" WIDTH="400" HEIGHT="200">
<center><font size="6" color="white">
<time begin="00:20"><center><i><b>The Arizona State University University Libraries</b></i></font>
<font size="4" color="white">
<br/>
<br/>

<time begin="00:22">A Visual Library Tour

<time begin="00:26"><clear/>

<time begin="00:28"><pos y="50">Welcome and enjoy a visual experience!</center></font>

<time begin="00:30"><font size="3" color="white"><i><b><p>-- LIST, ASU<b/></i></font></center>

</window>
```

4. map.rp code (for the slideshow):

```
<imfl>
  <head duration="01:05"
     width="450"
     height="425"
     bitrate="13500"
     preroll="00:20"
     aspect="true"
     timeformat="dd:hh:mm:ss.xyz"/>

   <image handle="1" name="hayden1.jpg"/>
   <image handle="2" name="hayden4.jpg"/>
   <image handle="3" name="noble-r.gif"/>
   <image handle="4" name="musicentrance.jpg"/>
   <image handle="5" name="architecture.jpg"/>
   <image handle="6" name="law.jpg"/>

  <fadein start="00:01" duration="00:02" target="1"/>
  <crossfade start="00:06" duration="00:15" target="2"/>
  <viewchange target="2" start="00:25" duration="00:05" srcx="290" srcy="139" srcw="118"
   srch="115"/>
  <crossfade start="00:30" duration="00:02" target="3"/>
  <wipe target="4" start="00:35" duration="00:08" type="normal" direction="down"/>
  <crossfade start="00:45" duration="00:08" target="5"/>
  <crossfade start="00:55" duration="00:10" target="6"/>
</imfl>
</window>
```

5. slideshow.rp code (codes for the slideshow):

```
<imfl>
   <head
     duration="04:15"
     bitrate="20000"
     width="450"
     height="425"
     aspect="true"
     timeformat="dd:hh:mm:ss.xyz"
      preroll="80" />

     <image handle="1" name="hayden.jpg"/>
     <image handle="2" name="hayden2.jpg"/>
     <image handle="3" name="hayden3.jpg"/>
     <image handle="4" name="hayden4.jpg"/>
     <image handle="5" name="hayden5help.jpg"/>
     <image handle="6" name="hayden6circ.jpg"/>
     <image handle="7" name="hayden7ada.jpg"/>
     <image handle="8" name="hayden8study.jpg"/>
     <image handle="9" name="hayden9ill.jpg"/>
     <image handle="10" name="hayden10workstation.jpg"/>
     <image handle="11" name="hayden11ref.jpg"/>
     <image handle="12" name="hayden12mars.jpg"/>
     <image handle="13" name="hayden13level1.jpg"/>
     <image handle="14" name="hayden14curr.jpg"/>
     <image handle="15" name="hayden15spcoll.jpg"/>
     <image handle="16" name="hayden16asia.jpg"/>
     <image handle="17" name="hayden17lab1.jpg"/>
     <image handle="18" name="hayden18gov.jpg"/>
     <image handle="19" name="hayden19azm.jpg"/>
     <image handle="20" name="hayden20ahf.jpg"/>
     <image handle="21" name="hayden21period.jpg"/>
     <image handle="22" name="hayden22currperiod.jpg"/>
     <image handle="23" name="hayden23micro.jpg"/>
     <image handle="1" name="hayden.jpg"/>

     <fill start="0" duration="00:01" color="#602030"/>
     <fadein start="00:02" duration="0:03" target="1"/>
     <crossfade start="00:10" duration="00:03" target="2"/>
     <crossfade start="00:20" duration="00:03" target="3"/>
     <crossfade start="00:30" duration="00:03" target="4"/>
     <crossfade start="00:40" duration="00:05" target="5"/>
     <crossfade start="00:50" duration="00:05" target="6"/>
     <crossfade start="01:00" duration="00:05" target="7"/>
     <crossfade start="01:10" duration="00:05" target="8"/>
     <crossfade start="01:20" duration="00:05" target="9"/>
     <crossfade start="01:30" duration="00:05" target="10"/>
     <crossfade start="01:40" duration="00:05" target="11"/>
     <crossfade start="01:50" duration="00:05" target="12"/>
     <crossfade start="02:10" duration="00:05" target="13"/>
     <crossfade start="02:20" duration="00:05" target="14"/>
     <crossfade start="02:30" duration="00:05" target="15"/>
     <crossfade start="02:40" duration="00:05" target="16"/>
```

```
<crossfade start="02:50" duration="00:05" target="17"/>
<crossfade start="03:00" duration="00:05" target="18"/>
<crossfade start="03:10" duration="00:05" target="19"/>
<crossfade start="03:20" duration="00:05" target="20"/>
<crossfade start="03:30" duration="00:05" target="21"/>
<crossfade start="03:40" duration="00:05" target="22"/>
<crossfade start="03:50" duration="00:05" target="23"/>
<crossfade start="04:00" duration="00:05" target="1"/>

<fadeout start="04:10" duration="00:5" target="1"/>

</imfl>
```

6. song.rt code (codes for the caption):

```
<window type="teleprompter" bgcolor="black" duration="266"><font color="white">
<br/><time begin="36"/>Welcome to our library.
<br/><time begin="37"/>The Hayden Library is located on Cady Mall.
<br/><time begin="40"/>The Library houses materials in the humanities and social sciences.
<br/><time begin="43"/>They include business and education.
<br/><time begin="46"/>It has a number of specialized collections including Government Documents.
<br/><time begin="49"/>1. **********************************************
<br/><time begin="52"/>2. **********************************************
<br/><time begin="263"/>**********************************************.
<br/><time begin="264"/>Welcome to our library.
</font>
</window>
```

INTERMATH[14]--PROFESSIONAL AND COGNITIVE DEVELOPMENT THROUGH PROBLEM SOLVING WITH TECHNOLOGY

Evan Glazer
University of Georgia

InterMath project group
http://www.intermath-uga.gatech.edu/

How can teachers teach a mathematics that they never have learned,
in ways that they never experienced?

Cohen and Ball, 1990

Abstract

InterMath is a statewide Internet-based (http://www.intermath-uga.gatech.edu/) project with the goal of designing and implementing a series of workshops and ongoing support programs that feature contemporary applications of ***technology*** *and* ***mathematics pedagogy*** *in the* ***middle-grades****. Technology is used to deliver the curriculum through web-based materials and to explore the mathematics using cognitive tools such as dynamic geometry software, spreadsheets, and graphing calculators. Objectives of InterMath include*

- *strengthening the middle school teacher's knowledge and understanding of mathematics,*
- *providing a support structure (on-line & in-school) to aid teachers in implementing and integrating technology tools for doing mathematics, and*
- *providing a structured inservice curriculum that follows Georgia's Quality Core Curriculum objectives as well as reform efforts expressed in publications by the National Council of Teachers of Mathematics.*

InterMath is a collaborative effort among the University of Georgia,, Georgia Institute of Technology, and nine regional technology centers in the state of Georgia. InterMath, a five-year effort to design and implement a series of field-based workshops and ongoing support programs to assist both teachers and administrators in effecting mathematics reform, is funded through the National Science Foundation.

Rationale

A Vision for School Mathematics

The pedagogical shifts embodied in a series of documents published by the National Council of Teachers of Mathematics (NCTM) emphasize vastly different approaches to mathematics teaching and learning than are typical in today's classrooms (NCTM, 1989, 1991, 1995, 2000). Rather than static knowledge and skills detached from both other domains and everyday events, mathematics is viewed as problem solving, reasoning, and communicating so that students are empowered to confidently "explore, conjecture, and reason logically [about the world around them]" (NCTM, 1989, p.5). This change in learning philosophy reflects a need for mathematics that is based in an information-rich and technology-based society. Learning goals should incorporate values that reflect mathematics for life, mathematics as a part of cultural heritage, mathematics for the workplace, and mathematics for the scientific and technical community (NCTM, 2000).

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[14] The InterMath project has been funded by the National Science Foundation [Grant #98766l l]. The views and opinions of the authors do not necessarily represent those of the National Science Foundation.

NCTM (2000) suggests that the direction of mathematics education should involve six core principles: equity, curriculum, teaching, learning, assessment, and technology. The equity principle stresses the need for reasonable expectations, opportunities, resources, and support for all students in learning mathematics. Students should have access to different forms of technology that will help them generate ideas and support their thinking. The curriculum principle focuses on the need to develop a clear, coherent plan to promote important mathematics. Concepts in the curriculum should relate to other mathematical ideas and be used to promote mathematical thinking and reasoning. The use of technology encourages these mathematical connections by allowing students to understand, visualize, and conjecture about new or unfamiliar concepts.

In reform-based mathematics classrooms, teachers are not merely keepers and transmitters of mathematical knowledge; they facilitate student engagement by posing relevant problems that encourage deep mathematical thinking involving analysis, problem finding and problem solving, that result in a rich conceptual understanding. Thus, the teaching principle emphasizes that teachers need to be well-versed in mathematics and pedagogy, including how students learn mathematics and the most effective learning environments, in order to fulfill this role. Similarly, the learning principle emphasizes the need for understanding mathematical concepts. According to the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989), conceptual understanding "enables children to acquire clear and stable concepts by constructing meanings in the context of physical situations and allows mathematical abstractions to emerge from empirical experience" (p. 17).

The assessment principle identifies assessment as a tool for enhancing learning and informing instructional decisions. Assessment should support continual and reflective learning based on values, multiple sources of information, and feedback, so that learners take responsibility for their ideas. Technology use not only influences how and what mathematics is taught, but it also gives students an opportunity to construct and express their mathematical ideas through their own creations and interpretations. However by itself, "technology is not a panacea" because any teaching tool can be used poorly (NCTM, 2000, p. 25).

Teachers should be provided extended opportunities to experience and do mathematics in an environment supported by diverse technologies (Dreyfus & Eisenberg, 1996). The development of mathematical understanding occurs when technology is used as a cognitive tool that supports thinking, reasoning, and problem solving (Jonassen and Reeves, 1996). The use of cognitive tools such as dynamic geometry, graphing calculators, spreadsheets, and symbolic processors, can provide opportunities and experiences for exploration, developing understanding, interpreting and communicating about mathematics (see Bransford, et al, 1996; Schoenfeld, 1982, 1989, 1992; Silver, 1987). Our approach in the InterMath project focuses on developing mathematical power--understanding, using, and appreciating mathematics.

Barriers to and Proponents of Reform

Reform, however, does not occur simply because new standards or approaches emerge. Several barriers have hampered reform efforts. One barrier appears to be linked to resilient and pervasive beliefs among preservice and inservice teachers as to what constitutes mathematics (Ball, 1988; Dossey, 1992; Thompson, 1984; 1992). Even and Lappan (1994) identified several widely held teacher beliefs: (1) computational proficiency is the major mathematics curriculum goal; (2) mathematical knowledge is rule bound and unconnected; (3) teaching is telling and learning is memorizing (p. 129). Howson, Keitel, and Kilpatrick (1981) noted that many curriculum projects fail because teachers tend to proceduralize methods in ways that are often inconsistent with the curriculum's underlying epistemological and pedagogical assumptions. This has been particularly evident in the use of widely available drill-and-practice programs that could be used to support emerging pedagogies, but rarely are. Cohen (1990), for example, documents the activities of a well-intentioned teacher who, based on lectures about reform mathematics, believed her methods were consistent with the current reform movement. However, she never actually experienced "doing mathematics" or learning mathematics in these new ways herself. While her intent and motives were admirable, the lack of experience in participating as a learner inherently limited her understanding and insight in implementing the approaches. In order to promote conceptual change, teachers must themselves experience mathematics as we want our students to: as conjecturing, reasoning, communicating, and

problem solving. Such experiences should prompt teachers to examine their fundamental beliefs about such questions as, "What is mathematics?," "What does it mean to know mathematics?," "How do students learn mathematics?," and "What is the role of the teacher in the mathematics classroom?"

Research in mathematics education suggests that a teacher's conception of mathematics has a strong impact on how mathematics is approached in the classroom (Cooney, 1985; Thompson, 1984; 1992). Furthermore, the nature of the classroom environment in which mathematics is done strongly affects how students view the subject and how it should be taught and learned. A common theme found throughout the reform documents is "What students learn is fundamentally tied to how they learn it" (NCTM, 1989, p. 5; NCTM, 1991, p. 21). Thus, if we want our students to view mathematics not as a static body of rules and procedures, but as a meaningful and dynamic, yet connected body of knowledge, we must make an impact on their teachers' views of mathematics.

In short, if we want our teachers to meaningfully teach mathematics, they must experience meaningful mathematics. In the words of Cohen and Ball (1990), "How can teachers teach a mathematics that they never have learned, in ways that they never experienced?" We cannot expect teachers to teach in a manner consistent with reform advocates simply because they have been told what to do or how to do it. To help our teachers meaningfully teach and model mathematical thinking, they must experience relevant mathematics as learners, benefiting from both the discovery processes as well as guidance from and modeling of capable peers. To break the cycle of stagnant curriculum and pedagogy, better teacher models are needed at all levels, K-12 through university.

Project Overview

Description and Goals

InterMath (http://www.intermath-uga.gatech.edu/) is a statewide Internet-based project with the goal of designing and implementing a series of workshops and ongoing support programs that feature contemporary applications of technology and mathematics pedagogy in the middle-grades.

InterMath has two primary teacher components:

- workshops comprised of in-class portions and a "follow-along" component in which participants create curriculum for use in their own classrooms.
- an ongoing system to support teachers beyond the initial laboratory/workshop.

Intensive support will be provided throughout the workshops under the close tutelage of InterMath facilitators distributed throughout the state. The site-based component will focus heavily on scaffolding in-school reform efforts. As participants near completion of the laboratory portion, they will transition to the ongoing support system--a peer community to ensure continuity beyond the laboratory.

The ongoing support system is supported by the Learning and Performance Support Laboratory (University of Georgia) and the Center for Education Integrating Science, Mathematics, and Computing (Georgia Institute of Technology) where shared resources and communication tools are provided; customization of support will be ensured through distributed implementation sites. Three INTECH (INtegrating TECHnology in the student-centered classroom) centers at the University of Georgia, Valdosta State University, and Kennesaw State University will be initially certified as InterMath sites. They will then mentor both subsequent InterMath INTECH centers as well as serve as regional support base for participants. During the project, we will establish a geographically distributed community of educators, K-12 through universities, who are committed to sustaining technology-enhanced middle-grades mathematics teaching and learning reforms. This community will be connected and supported through shared web-based resources, e-mail, and listservs.

Project goals and objectives reflect multiple targets aimed at involving teachers and administrators in technology-enhanced mathematics reform. They link the epistemological, pedagogical, and logistical activities designed to support QCC and NCTM standards.

Goal 1: Promote innovative practices in the tool uses of technology in middle-grades mathematics teaching and learning.

- To use technology tools to model and demonstrate standards-referenced mathematics content and pedagogy for the middle school.
- To enable teachers to experience mathematics using various technologies so that they can explore real world applications, engage in problem solving, and communicate about their investigations.
- To use technology to understand the distinction between demonstration and proof in mathematics and to emphasize the value of each in the understanding of mathematics.
- To use technology to engage in mathematics explorations, to form mathematics ideas, and to solve mathematics problems.
- To use technology tools to construct new and personally meaningful ideas of mathematics.
- To use general tools such as word processing, paint programs, spreadsheets to facilitate mathematics investigations and communication.

Goal 2: Revitalize middle-grades mathematics teaching and learning by modeling, then applying, innovative technology-enhanced approaches.

- To develop effective mathematics demonstrations using appropriate technology tools.
- To engage in independent investigations of mathematics topics from the middle school curriculum or from mathematics appropriate for that level.
- To communicate mathematics ideas arising from technology-enhanced investigations.

Goal 3: Support reform of mathematics teaching and learning in middle grades mathematics classrooms.

- To enable middle grade mathematics teachers to develop and adapt materials and goals from standards -based curriculum through the use of technology.
- To model and explore collaborative instructional strategies.
- To develop mechanisms and expectations of sharing instructional ideas, materials, and information among middle school mathematics teachers.
- To support comprehensive standards-based middle school mathematics curricula and the implementation of Quality Core Curriculum and NCTM goals.
- To utilize technology tools in the implementation of alternative assessment strategies.

Goal 4: Establish the human and technological infrastructure needed to sustain meaningful reform of middle grade mathematics instruction.

- To develop confidence in technology use as teachers explore, practice, reflect, and become adept in technology-enhanced teaching and learning of mathematics
- To enable and encourage middle school mathematics teachers to collaborate by using technology support.
- To support professional development opportunities for middle school mathematics teachers and other key personnel through a network of peer teachers.

Professional Development

Workshop Procedures

The workshops are intended to immerse teachers in active problem solving with technology. Participants will explore different concepts each class meeting by working through various InterMath investigations and writing about one in-depth. Each participant will build a personal web page using artifacts and productions from the workshops to compile an electronic portfolio. Write-ups and projects, reflecting participants' synthesis and reflection about their explorations, will be submitted electronically for workshop credit. The purpose and focus of a write-up is to communicate and synthesize investigations involving exploration, solving a problem, or working with an application. The key elements of a write-up consist of the learner's synthesis, communication, mathematical ideas, interpretation, and utility of an investigation. Final projects, focusing on a technology-enhanced mathematics investigation of the

individual participant's determination, will be submitted and discussed at the end of the workshop/laboratory. Participant productions will be placed on the web page for public sharing.

The laboratory leader will present demonstrations and explanations, clarify problems, and demonstrate alternative solutions using a projected image from the leader's workstation. In a typical session, a leader might allocate one-third of the time in whole-group mode, and during the balance of the meeting provide direct support for participants working on their projects or units, either individually or in groups. The InterMath web site (http://www.intermath-uga.gatech.edu/) will enable participants to work at their home or school sites.

In addition to the 45-hour workshop, the 55-hour "follow-along" course will promote the use of technology to enhance mathematics teaching in their home school and to extend each participant's expertise. This additional component to the workshop promotes reflective practice among the participants, emphasizing realistic applications of technology in middle school teaching. Each participant's web page contributions will include conceptual work, projects, activities for their classroom, and links to related teaching-learning resources in order to establish a highly connected framework of resources.

Participant Selection and Credit

Participation will be open to all middle school educators in Georgia, but teachers from historically underserved schools will receive top priority. Applications will be solicited from schools located within the service areas of the participating sites (First year: University of Georgia, Kennesaw State University, and Valdosta State University).

It is expected that a team of selected teachers will participate in the workshops and at least one administrator will participate in a minimum of 20 hours of professional development as part of the team. It is also imperative that each teacher member has classroom Internet access and there is e-mail access for all team members. Teams with a minimum of one teacher of mathematics from each grade level (4-8) represented in the school will receive priority in the selection process.

Credit could be in the form of graduate hours or staff development units depending on the institution offering the workshop. InterMath participants need to check with the site at which they will be participating to determine what type of credit they will receive. If graduate credit will be offered, participants will likely have to apply and be admitted to the graduate school at that particular institution.

Administrative Support

Administrative support and leadership are key in both promoting and sustaining school innovation. Several authorities advocate models that tie professional development to a particular school and are explicitly linked to reform activities that the individual school is undertaking (Darling-Hammond, 1995; Davis & Padilla, 1991; Lieberman, 1995). Therefore, administrative support in school improvement plans influences teacher and student use of technology. The target administrators for InterMath are building level personnel with primary responsibility for instructional leadership, i.e., principals, assistant principals, instructional specialists. However, central office administrators with responsibility for curriculum design, professional development, student assessment and the support of instructional technology are also encouraged to participate in the InterMath program.

In the InterMath workshops, administrators will engage in hands-on activities using the Internet to support teachers in their efforts. This participation will ensure that administrators better understand the power and potential of the learning activities, the technical needs of the teacher, and the classroom management techniques that complement technology-enhanced learning experiences. Administrators will be encouraged to share their ideas, problems, solutions, and successes for supporting their teachers. Thus, InterMath workshops can provide a forum to reduce administrator isolation and support administrators in follow-up activities including instructional leadership and teacher evaluation.

Our Use of Technology

The InterMath workshop intends to illustrate *how* and *when* technology can be used appropriately in the mathematics classroom. The literature describes two distinctly different approaches in the use of technology in classrooms: using the computer as a tool for exploration or problem solving and using the computer as a tutor that delivers instruction and provides feedback. Research on the use of computers in mathematics as a tutor and a tutee are usually not situated in problem solving environments. Most tutor-based technologies are in the form of drill and practice software, which tend to rely on lower ordered skills, and are often negatively related with student achievement (Jonassen & Reeves, 1996; Wenglinsky, 1998). Jonassen and Reeves (1996) argued that higher-order thinking occurs in environments where the student is learning with, and not from, the computer. It is this approach that InterMath promotes and intends to develop among its participants.

Many studies investigating technology-enhanced environments include an emphasis on conceptual development situations. For example, when calculators and computer software perform calculations and simplifications, teachers have more time to emphasize why something is happening, instead of focusing on algorithms (Grassl & Mingus, 1997; Heid, 1988; Maury, 1987; Palmiter, 1991). Moreover, the imperfections in calculator graphs and computations also provide opportunities for conceptual development. For example, Dion (1990) found cases where the graphing calculators' resolution caused certain functions to appear differently than they are supposed to. In addition, Goldenberg (1998) found that the graphing calculator window can provoke critical inquiry because different functions can appear to look the same if they are on different domain and range windows. Finally, Burrill (1992) noticed that the calculator has difficulty simplifying computations with extremely large and small numbers, consequently producing an incorrect answer. Used appropriately, these situations expose misconceptions and help students develop a richer understanding of the mathematics being studied.

Technology Applications and Facilities

The technologies used in the InterMath program range from low-end, hand-held calculators through high-end multimedia workstations. Computer software applications including spreadsheets, graphing tools, dynamic geometry, web editing, and Internet will be used regularly throughout the workshops. Technology will be available and supported both at INTECH sites and in the participants' schools. All INTECH labs have high-speed Internet access to support individual workstation, local network, and web-based mathematics activities and applications. The laboratory also affords ready access to non-computer technologies, including graphing calculators and manipulative materials.

Cognitive Development

Rationale of Workshop Activities

In designing the workshops, we have kept in mind the work of Malone and Lepper (1987) concerning the design of instructional environments that are intrinsically motivating. They have identified four sources of intrinsic motivation in learning activities: (1) gives an appropriate level of challenge, (2) appeals to the sense of curiosity, (3) provides the learner with a sense of control, and (4) encourages the learner to be involved in a world of fantasy in which learners can experience vicariously rewards and satisfactions that might not be available to them otherwise. While a workshop leader may not be able to incorporate all of these sources of intrinsic motivation into every learning activity, incorporating at least one appears to increase the likelihood that the activity will be intrinsically motivating.

Pertaining to the first source of intrinsic motivation, we have included a variety of problems on a continuum of difficulty levels. By posing challenging problems within a familiar context, teachers will develop confidence in problem solving and thus will more likely engage in the activities. The context of the problems enables teachers to safely sample and reflect on their own approaches to problem solving. The second source of intrinsic motivation is appealing to the sense of curiosity. Activities can stimulate curiosity by introducing ideas that are surprising or discrepant from the learner's existing beliefs and ideas. While the mathematical problems posed in the laboratories will center on middle-school curriculum, they

are more open-ended and generative than is typically seen in a traditional middle-school curriculum. Problems can be used as a springboard for ideas and investigations that participants find personally intriguing. Furthermore, teachers will be able to choose among several activities in which to actually engage. They can choose activities that are most applicable to their classroom needs and relevant to their mathematical understanding. Since participants can choose activities based on their preferences, the third source of intrinsic motivation (providing the learner with a sense of control) will be reflected throughout the laboratory.

The fourth source of intrinsic motivation is encouraging engagement through fantasy. As an example of a task using fantasy, consider the following problem requiring the use of the Pythagorean theorem:

> The learner needs to calculate the distance from point *a* to point *b* in order to inform Captain James T. Kirk about how to set the transformer beam on the Federation Starship *Enterprise* so they can pick up the necessary dilithium crystals directly below on the planet's surface. Kirk only knows the distances of the ship and the crystals from a third point where his scouting party has stopped (Lepper & Hodell, 1980).

Fantasies are more intrinsically motivating when they employ characters and situations with which the learner can identify. Faced with either this fantasy-like problem or a series of abstract problems in which learners are asked to find the length of one side of a triangle, one can imagine which type of problem learners would prefer.

The philosophy permeating InterMath is that teachers must relearn mathematics in a more open-ended, generative manner so they may come to understand what reform documents intend by "meaningful learning." Furthermore, by encouraging teachers to create and modify their own curriculum units, InterMath attempts to avoid what Howson, et al. (1981) warn may be a cause for failed reform -- teachers failing to assume ownership of reform.

Workshop Content

The mathematics content and concepts of InterMath reflect curriculum that would enhance a teacher's understanding of middle-grades mathematics. The laboratory centers on the middle-school mathematics curriculum per Georgia's Quality Core Curriculum (QCC) and the NCTM Standards (1989, 2000). The InterMath curriculum is meant to engage teachers and is intended to deepen teachers' understanding of mathematical concepts related to the middle school curriculum. Thus, the investigations would likely need to be modified for use with middle school students.

There are 14 units that can be used for InterMath workshops. Thirteen units are called Fraction and Decimals, Integers; Ratios, Proportions & Percents; Quadrilaterals, Triangles, Polygons, Probability, Statistics, Solids, Circles, Graphs, Patterns, Functions & Equations. The fourteenth unit is comprised of over 200 problems adapted from *Teaching Mathematics in the Middle School* (NCTM). The following criteria have been used to highlight recommended investigations for teacher exploration:

- Multiple cases can be investigated using technology.
- Pre-Algebra students can rely on technology to investigate the situation.
- The investigation promotes generalizability or can be used as a springboard for further exploration.
- Multiple methods can be used to explore the situation.
- Multiple solutions are possible.
- The investigation, based on middle school mathematics, is easy to start exploring.
- The investigation can be modified for use in a middle school classroom.

The following investigation exemplifies these principles:

Choose two numbers. Add them together and form a Fibonacci-like sequence, starting with your first two numbers, and ending with a total of ten numbers. For example, if your first two numbers are 3 and 5, then your third number is 8 (3+5), your fourth number is 13 (8+5), your fifth number is 21 (8+13), and so on. Determine a relationship using the seventh term and sum of the terms of your sequence. Is this true for *every* sequence of this nature? Explain.

- Multiple cases can be investigated using technology.
  The use of formulas in a spreadsheet allows teachers to change the initial two numbers and instantly view calculations of the remaining 8 terms and the sum of the sequence. As multiple cases are tested, a formula relating the seventh term and sum of the sequence can be hypothesized, tested, and modified.

- Pre-Algebra students can rely on technology to investigate the situation.
  While students can conceivably make a reasonable conjecture about this investigation using a few cases, they will need an algebraic proof to verify that their conjecture is true. The use of technology in this case amplifies the confidence in their conjecture because multiple cases can be tested.

- The investigation promotes generalizability or can be used as a springboard for further exploration.
  Following the experimentation process with technology, teachers are encouraged to question why a particular pattern develops and then investigate a proof. Furthermore, after answering the initial question, teachers may develop further questions, such as:
  1. Will this hypothesis be true for negative numbers?
  2. Will this hypothesis be true for decimals and fractions?
  3. Are there relationships between the sum and other terms in the sequence?

- Multiple methods can be used to explore the situation.
  A spreadsheet can be used in a variety of different ways to investigate this situation. For example, students can construct one table that continually changes, or a grid with multiple tables. In addition to spreadsheets, symbolic manipulation can be used to investigate this problem.

- Multiple solutions are possible.
  Many people will propose that 11 times the 7^{th} term will equal the sum of the sequence. In addition, multiple linear combinations are also acceptable, such as six times the 7^{th} term plus 2 times the 9^{th} term minus the 4^{th} term will equal the sum of the sequence.

- The investigation, based on middle school mathematics, is easy to start exploring.
  Only basic arithmetic operations are used in this investigation. Most people begin using positive integers in their exploration, and then later broaden their scope to different types of numbers such as negative integers, fractions, decimals, and irrational numbers.

- The investigation can be modified for use in a middle school classroom.
  This investigation can be immediately adopted in the middle school classroom if the intention is to teach pattern recognition and creation of formulas from data. However, a shorter sequence might be used in the classroom if the teacher intends to illustrate adding like terms, using the distributive property, and creating linear combinations with variable expressions.

Next Steps

InterMath is in its second year of a five year project. Over the past year, the web-based InterMath materials have been developed and tested with various teachers in the state of Georgia. This year the project will run workshops in the spring and summer semesters to build a community of teachers that will develop technology-enhanced materials for their classrooms. In addition, we intend to develop an ongoing support system that will encourage a sustained effort among teachers in the InterMath program. The goal

at the end of the five year project is to have a self-sustaining system of resources, tools, and people with a common goal of enhancing mathematics education using technology as a catalyst for change.

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