DOCUMENT RESUME

ED 396 746 IR 017 959

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TITLE Perspectives on the Place of Educational Theory in Multimedia.
PUB DATE 96
NOTE 6p.; In: Learning Technologies: Prospects and Pathways. Selected papers from EdTech '96 Biennial Conference of the Australian Society for Educational Technology (Melbourne, Australia, July 7-10, 1996); see IR 017 931.
PUB TYPE Speeches/Conference Papers (150) -- Viewpoints (Opinion/Position Papers, Essays, etc.) (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Style; Computer Uses in Education; Constructivism (Learning); Educational Strategies; *Educational Technology; *Educational Theories; Foreign Countries; Information Technology; *Learning; Multimedia Instruction; *Multimedia Materials; *Teaching Methods
IDENTIFIERS Listservs

ABSTRACT

A number of themes and issues emerge in any discussion about educational theory, learning and instruction. Interactive multimedia provides another vehicle to consider and reconsider the place of educational theory, and particularly theories centered on student learning, in the design of multimedia. This paper discusses some of the prevalent issues that emerged as part of the educational theory strand to the Mini-conference for Practitioners of Educational Interactive Multimedia (Curtin University, Australia, July 7-9, 1995). The paper also reflects issues related to a similar debate being had more widely amongst developers and users of interactive multimedia, a debate particularly evident from time to time on IT-FORUM, an electronic listserv, designed as a virtual forum for debate in the field of instructional technology. Issues discussed include: a definition of the term "learning"; the learner's style and approach to learning; context and situation for learning; the role of constructionism; conditions of learning; and cognitive tools for learning, including the role of the computer as a cognitive tool. Guidelines for the implementation of multimedia for effective instruction will be different depending on each individual person's learning style and approach to learning, and the nature and context of the instructional situation. For some instructional situations, it is relatively easy to provide a set of guidelines for effective instruction. For others, it is impossible to provide "guidelines" but possible to describe the types of "conversations" or "interactions" between instructor and learner that contribute to, and even define, the learning process. Multimedia as a technology imposes a set of restrictions upon learning, as well as some opportunities. These restrictions are not always present in more traditional instructional contexts. As a result, multimedia may not be an ideal medium for all types of instruction--it does not, for example, represent conversation, dialogue, or negotiation very well as learning processes. (Contains 21 references.) (Author/SWC)

Perspectives on the place of educational theory in multimedia

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A number of themes and issues emerge in any discussion about educational theory, learning and instruction. Interactive multimedia provides another vehicle to consider and reconsider the place of educational theory, and particularly theories centred on student learning, in the design of multimedia. What follows in this paper, is a discussion of some of the prevalent issues that emerged as part of the Educational Theory strand to the Mini–conference for Practitioners of Educational Interactive Multimedia (Curtin University, 7–9 July, 1995). The paper also reflects issues related to a similar debate being had more widely amongst developers and users of interactive multimedia, a debate particularly evident from time to time, on IT–FORUM.*

Invariably, we need to look towards educational theories to engage and underpin approaches to instructional design. To what extent, however, should a given instructional approach reflect a holistic and integral view or theory of student learning? Is it appropriate, for example, to approach the design process eclectically, using a mixed bag of theories or frameworks to rationalise a particular instructional design? Whatever the answers to these ever–present questions, there are a number of theoretical frameworks that deserve particular attention in this context. Some of these are considered below.

What is meant by 'learning'?

In the context of this paper, learning it is suggested, should be seen in terms of cognitive change. That is not to suggest that other learning of an affective or psychomotor sort is not of importance, or that interactive multimedia does not provide for such learning—but rather, in tertiary contexts at least, cognitive development in learners is perhaps the central aim of most instruction. Furthermore, Laurillard (1993) describes the academic knowledge necessary to cognitive development in domains studied at tertiary level, as being different to other levels or types of knowledge, particularly everyday knowledge. That is, learning at tertiary level necessarily includes not only learning knowledge in real–world contexts (experiential learning) but also learning others' descriptions of the world (academic learning) (Saljo, 1984).

The learner

We probably need to account for two important and different considerations here: the learner's style as well as their approach to learning. Learning styles and learning approaches represent two different perspectives on student learning processes, each of which appear to influence academic achievement (Murray–Harvey, 1994). Also, both are conceptualisations that provide a framework for understanding how students learn and why there are differences between students' learning, in terms of learning outcomes.

Broadly speaking, the theory underpinning measurement of learning styles is that students possess biologically determined learning preferences in respect of environmental, emotional, sociological, physical and psychological conditions (Price, Dunn, & Dunn, 1991). Varying preferences for each of these learning conditions, combine to provide an individual learning style profile. In addition, since preferences are largely biologically determined, a learner's learning style

will necessarily be resistant to change, implying that instruction needs to take account of learning styles rather than trying to change them (Murray–Harvey, 1994).

In stark contrast to this conceptualisation, Biggs (1987a, 1987b) suggests that the process of learning is determined by students' approaches to learning—that is, a composite of students' motives and strategies (to learn) as well as their perceptions of tasks. Importantly, different approaches to learning (and their are four prime approaches: surface, achieving, deep and deep–achieving), are open to change and development, according to changes in motives, strategies and task perceptions (Biggs, 1987a; Biggs, 1987b). Furthermore, it is contended that deep and deep–achieving approaches to learning are more likely to result in better learning outcomes; and as such, instruction should be provided to encourage students to develop these approaches to learning.

Context and situation

It is often argued that context and situation are all important in providing for learning at all levels, and should influence in particular, the design of instructional multimedia (Herrington & Oliver, 1995). Collins (1989) describes situated learning thus, 'situated learning is the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life' (p2). In the same context, Collins, Brown and Newman (1987) argue strongly for the effectiveness of cognitive apprenticeship models of pedagogy, where, it is suggested, 'teaching methods should be designed to give students the opportunity to observe, engage in, and invent or discover expert strategies in context' so that they might best learn both cognitive and metacognitive skills' (p12).

It is not clear, however, that the concept of situated learning allows for the levels of abstraction required for understanding in many domains of knowledge, particularly those studied by university students. For example, Laurillard argues cogently that learning in situated contexts does not, by itself, allow for a learner to make abstractions from the particular context and therefore be able to generalise or even be able to apply what is learnt to new situations or contexts (Laurillard, 1993). This has, in particular, an important implication for learning what Laurillard classifies as 'academic knowledge'—she considers academic knowledge to be different to everyday knowledge, drawing a distinction between learning 'percepts' in everyday life and learning 'precepts' in education, implying that learning precepts necessitates students building understanding in a deeper (abstract) sense, a level of understanding which cannot be provided for simply by situating the learning experience (Laurillard, 1993, 23–29).

A note on constructionism

We should probably not resist the temptation to comment upon the nature and role of constructivism in a discussion of issues related to educational theory, learning and multimedia (particularly since constructivism is often misconstrued and misrepresented). There are a whole range of theories concerned with the way in which students learn which together inform what is usually meant by 'constructivism'; some theories emanate from a cognitivist tradition, others from a social psychological, interactionist or experiential perspective (and the list could go on). However, in much of the current and recurring debate about the role of educational and learning theory in instructional technologies (especially multimedia), there seems to be a readiness to polarise one theory of learning (behaviourism) with a metatheory (constructivism), and, further, to present the former as grossly deficient and the latter as the only credible explanation of student learning.

The difficulty here is that such a polarisation is entirely philosophical, and as such represents fundamentally different views on what is meant by knowing, the role of education and the nature of learning. The polarisation, outside of a philosophical debate, is certainly not helpful in determining effective instructional design. For example, even although the main components of behaviourism (or at least the behavioural theory of Skinner) were largely discredited as general truths in the 1970s, the principles of contiguity, repetition, reinforcement through feedback and motivation are still recognised as important in processes of learning (Entwistle, 1987). Indeed, there are various dimensions in different theories of learning, and not all fit along an imaginary continuum connecting two supposed extremes—this is where Reeves' work on the evaluation of instructional technologies is misleading (Reeves, 1994). If we need a metaphor to represent learning or educational theories as a whole, a series of corresponding and opposing objects, each with its own attributes, some common,

some unique, is ultimately a more accurate and useful metaphor than a simple, linear path connecting two poles or extremes.

Perhaps the overriding point is that, in designing and evaluating interactive multimedia we must be prepared to refer to explanations of student learning to describe the most appropriate way of addressing a particular learning situation. Also, that all theories or explanations of learning, be they psychometric, humanistic or behaviouristic, are each credible in helping to understand certain kinds of learning; but that each theory is also partial in that it refers to a limited range of learning situations and that it is often based on a limited set of data.

Conditions of learning

From the phenomenographical research of Marton (Marton, Hounsell, & Entwistle, 1984; Marton & Ramsden, 1988), Saljo (1984) and Thomas and Harri–Augustein (1985), it is useful to consider the notion of the ultimacy of individuality in learning, that learning is different for individual learners; and that learning involves a negotiation of meaning (in the form of conversation), within and between learners, which leads to understanding. To describe what is successful in learning, in this context, is to describe successful interactions between learner, context and instruction. Thus, it is not possible to distil from such interactions a set of prescriptive conditions of learning, since the interactions that might be described will be rooted in a particular context and therefore are likely to be context specific and non–generalisable.

Given this premise, if we take it as so, how is it possible to reconcile an approach to instructional design that strives to describe the necessary conditions of learning for all learners and for all learning situations? Well, quite simply, it isn't. However, for instructional technologies at least, the influence of Gagne's *The Conditions of Learning* (Gagne, 1977), and more lately, Merrill's work (Gagne & Merrill, 1990), continues to have a tremendous impact on instructional design, particularly for instructional multimedia—Laurillard describes both as 'key figures in instructional design' (Laurillard, 1993). Merrill has even purported to have computerised this approach to instructional design (Merrill, Li, & Jones, 1990).

In fact, Merrill has recently published a defence and rationalisation of instructional design as a science, against the encroachments of what he terms, 'those persons who claim that knowledge is founded on collaboration rather than empirical science, or who claim that all truth is relative...' (Merrill, et al., 1996). In this recent work, he makes a number of crucial points, attempting to re–establish the authority of an instructivist and philosophically uncompromising approach to instructional design:

- There are known instructional strategies. The acquisition of different types of knowledge and skill require different conditions for learning (Gagne, 1977). If an instructional experience or environment does not include the instructional strategies required for the acquisition of the desired knowledge or skill, then effective, efficient, and appealing learning of the desired outcome will not occur.
- These instructional strategies (conditions of learning) can be verified by empirical test.
- Appropriate instructional strategies can be discovered, they are not arrived at by collaborative agreement among instructional designers or learners. They are based on natural principles which do exist, and which nature will reveal as a result of careful scientific inquiry.
- Many persons associated with educational technology today are engaged in a flight from science. Instructional design is a scientific and technological field. It is not merely philosophy; it is not a set of procedures arrived at by collaboration; it is a set of scientific principles and a technology for implementing these principles in the development of instructional experiences and environments.

Cognitive tools

One way of embracing the findings of phenomenography and using these to provide for new models of instructional design, is to consider the role of the computer as a cognitive tool; that is, to conceptualise the computer as tool to engage the learner in interactions—principally with their own meanings or understandings, as well as those of others, in order to build a more complete, richer, understanding. The notion of computers as cognitive tools is not new (it's certainly as old as educational computing itself), and it has a theoretical base in mental models theory. Johnson–Laird (1983) explains mental models thus:

> Understanding certainly depends on knowledge and belief. If you know what causes a phenomenon, what results from it, how to influence, control, initiate, or prevent it, how it relates to other states of affairs or how it resembles them, how to predict its onset and course, what its internal or underlying 'structure' is, then to some extent you understand it. The psychological core of understanding, I shall assume, consists in your having a 'working model' of the phenomenon in your mind. If you understand inflation, a mathematical proof, the way a computer works, DNA or a divorce, then you have a mental representation that serves as a model of an entity in much the same way as, say, a clock functions as a model of the earth's rotation. (p2)

By providing interactive and perhaps multimedia environments on the computer, which are able to accommodate learners' representations or models of conceptual phenomena and allow for predictions, explanations and simulations, then we are providing the means by which learners can represent, explicitly, their own understandings, interact with others' (teacher's or students') representations and come to understand a range of conceptual meanings in relation to their own. The computer, in the shape of a cognitive tool, allows the learner to externalise their thinking, to enrich it, manipulate it and change it, all by interacting with one or more conceptual models on the computer, in the form of a dialogue (whether that dialogue is real and conducted with others, or whether it occurs in the learner's head).

Thus, instead of designing instruction in the form of predetermined instructional goals, each matched with an artificially constructed learning event (Gagné, 1977), it is possible to enable the learners themselves to design by expressing their representations or models of understanding, and by doing so, engage in meaningful cognitive interactions. Jonassen and Reeves describe this process thus:

> Instead of specialists such as instructional designers using technology to constrain students' learning processes through proscribed communications and interactions, the technologies are taken away from the specialists and given to the learners to use as media for representing and expressing what they know. (Jonassen & Reeves, in press)

Jonassen and Reeves (in press), limit their view of what constitutes a cognitive tool on the computer. However, for the computer to act as a cognitive tool, it is important, in terms of mental models theory, simply to allow for the building of computer models, which are beneficial to the processes necessary in constructing accurate and appropriate mental models (Wild, 1996).

Conclusion

So, what is the place of educational theory in interactive multimedia and more particularly, in instructional design for multimedia? Are there guidelines that can be drawn for the implementation of multimedia for effective instruction? Well, yes there are, for some people, in some contexts—but they will be different, depending upon one's views of epistemology, not to mention the nature and context of the instructional situation. For some, it is relatively easy to provide a set of guidelines for effective instruction—and this has been done already, for different types of learning (e.g. for the acquisition of verbal information, intellectual skills, cognitive strategies and attitudes), by Gagne and Merrill, amongst others. For others, it is impossible to provide a set of *guidelines* for effective instructional multimedia—but it is possible to describe the types of 'conversations' or 'interactions' between instructor and learning, that contribute to, and even define, the learning process (in this case, the emphasis being upon a negotiation of understandings and meanings).

In a final comment, it is perhaps sobering to remember that multimedia, as a technology, imposes a set of restrictions upon learning—as well as some opportunities. These restrictions are not always present in more traditional instructional contexts and we should perhaps consider that multimedia is not an ideal medium for all types of instruction—it does not, for example, represent conversation, dialogue or negotiation very well, as learning processes.

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Acknowledgments: Thanks to Dr Clark Quinn, Dr Carmel McNaught and Associate Professor Shirley Alexander for providing valuable comments and criticisms on drafts of this paper.

Note: IT–FORUM is an electronic listserv, designed as a virtual forum for debate in the field of Instructional Technology. The listserv is moderated by Dr Lloyd Reiber at the University of Georgia (LRIEBER@MOE.COE.UGA.EDU); to join IT–FORUM, send SUBSCRIBE ITFORUM <firstname secondname>, leaving the title field blank, to LISTSERV@UGA.CC.UGA.EDU: