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ABSTRACT

This proceedings of the Association for Applied Interactive Multimedia 1993 conference includes the following papers: "Multimedia in Education and Training: 'Promises and Challenges'" (H. D. Ellis); "Critical Thinking in the Multimedia, Self-Paced English Classroom" (L. Mortensen); "Computer Assisted Instruction" (C. Whitehouse); "Cyberteaching: Teaching about and within Cyberspace" (G. Cartwright & M. Silva); "Developing a Prototype Multimedia Laboratory" (B. Gleason, A. La Salle, & G. McGuire); "Developing an Interactive Database on a Shoestring Budget" (P. Baker); "Development and Evaluation of a Hypertext-Based Multimedia Tutorial for Use in New Employee Orientation" (A. Snyder); "Educational Technology at the University of Notre Dame: Supporting Faculty Development" (C. Williams & T. Laughner); "From Hypertext to Hypermedia" (W. Strang, H. Khan, V. Simpson, D. Slater, & S. Hill); "How Much is Enough? Choosing a Computer-Based Video Technology" (M. Pearce); "Integrated Biochemistry Learning Series (IBLS): A Learner Controlled, Multimedia Program for Medical Biochemistry" (S. Dennis & J. Baggott); "Interactive Multimedia CAL as a Tool for Higher Education in the UK" (R. Beresford, T. King, & D. Ross); "Introducing Multimedia Applications into the Curriculum Using IBM Technology" (B. Scarbeau); "Media Field Trip to a Rocky Intertidal Zone" (R. Russo); "Medialink: A New Method for Authoring Multimedia Lessons for the Classroom" (R. Oakman, J. Waller, & F. Fenimore); "Multimedia on a Shoestring" (M. Payne); "Meeting the Challenge: Creating Multimedia To Teach Critical Thinking Skills" (S. Colton); "Multimedia: A New Vision for the Classroom" (P. Bergeron); "Multimedia in a Third World Nation--Panama" (C. Lam, B. Martinson, & V. Barragan); "Multimedia for Speaker Support: Issues in Design, Programming, Synchronization and Media Integration" (J. Gorrono & K. Weiss); "Multimedia User Interface Design for Computer-Based Training" (J. Morris, G. Owen, & M. Fraser); "Student Developers: Learning through Creating Multimedia Term Papers" (P. Fox); "Specification of a European Public Multimedia Information Service" (M. Hoogeveen & J. Andersson); "Teaching Physical Skills Using DVI and Dataglove Technology" (J. Hazard); "The Educational Effects of the Classroom Presentation Option" (D. Moser, L. Halloran, J. Burke, & J. Hamer); "Total Quality Instructional Design: Integrating Instructional Design and TQM" (S. Corvey & L. Legg); "Using Multimedia with Large Lecture Sections, Does it Work?" (A. Karpoff & C. Rude-Parkins); and "Visualizing Spatial Relationships: A Multimedia Training Environment" (T. Russo & L. Mowafy). Also included are abstracts of 28 papers and information on preconference, technical, and concurrent sessions. (TMK)

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ABSTRACT INDEX

July 16, 1993

The Association for Applied Interactive Multimedia was created to support professionals who are using and developing interactive multimedia. The association began with a small group interested in supporting and contacting others in the development and creation of multimedia. In the last two years the organization has grown to include professionals from the areas of medicine, business, industry, higher education, K-12 education, and government. This summer we are excited to sponsor the Second Annual Conference on Multimedia in Education & Industry, "Promises & Challenges."

I have asked the speakers of the AAIM conference to provide papers or short abstracts which contain information about their presentations. The papers have been compiled into these proceedings for you to use as a valuable resource about multimedia after the conference. The papers and abstracts in the proceedings are organized by strand and then alphabetically by author's last name. Should you desire to contact any speaker by mail, complete addresses are provided at the end of each paper.

I would like to thank all the speakers at this conference for their generous contribution of their time and experiences. I especially appreciate their willingness to provide these papers in advance of the conference.

Carl Helms

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FEATURED KEYNOTE

MULTIMEDIA IN EDUCATION AND TRAINING: "PROMISES AND CHALLENGES"

H. Dan Ellis

ABSTRACT

Attempts to use computer technology in training and education extend back some fifty years, with few successes in education, but recently more success in training. In this decade, the name of the game is productivity; using technology to affect the various components of the learning industry - quality, retention, dollars per graduate, effectiveness, time to graduation and so on - for the better. Most other industries have been successful in raising productivity by capital investment in technology; but not the education industry, and training has fared little better. Will multi-media make the difference? What is it about multi-media that has people excited? Is it the glitz? The potential for greater profits for the computer industry? Or is there a way to use multi-media in a way that produces low-cost, high-retention, certifiable learning?

The presenter will ask some interesting questions, will show some thought-provoking uses of various technologies in learning facilitation, and may even provide a few answers! The audience will be shown how effective training and learning outcomes might be achieved, with enthusiasm on the part of the learner, using high quality, technology-based training packages, developed in a reasonable time-span at a reasonable cost, AND with minimal risk of losing your money on a product which doesn't do the job!

This keynote will set the tone for further discussion throughout the conference; the aim is to start a process of empowerment to help delegates enlist enthusiastic management support and funding for effective multi-media based learning and training projects, and to deliver on promises, so that management becomes eager to thrust more money your way!

INTRODUCTION

The promise of multi-media in training and education is the prospect of lower costs, speedier learning, greater retention (of both students and subject matter), higher quality, greater interest for the learner, a life-long love affair with learning, and in general the kind of productivity gains realised in other industries by injecting capital. And there is lots of room for improvement. The US Congress Office of Technology Assessment in 1988 identified education as the economic sector with the poorest productivity record of any major American industry. On the other hand, I can't think of any more difficult process than education, and that is the challenge; HOW can we use modem computer technology to help in one of the most difficult processes people can attempt - learning something new.

Teaching is something people do that they hope will result in learning - the names of bones, special relativity, abstract concepts in philosophy, even learning strategies. It is tempting to take the view that multi-media will finally unlock the gate separating the promise (of technology bringing about a revolution in education) from its realisation. After all, multi-media can be very exciting, very engaging, can provide an array of sensory input, can simulate processes and show people, places and events from the past and present. It can allow free-range exploration, guided exploration, hyperbrowsing, highly structured learning experiences, and all on relatively inexpensive technology. So what is the truth of the matter? Just how much value does multi-media (and technology in general) add to training and education? Before discussing my own answers to these questions, let me tell you a story.

In 1985, I sent questionnaires to 600 university physics departments throughout the world, with the aim of discovering which computer assisted learning projects had achieved success in helping students learn first year physics. The remarkable story which emerged from the US Air Force Academy (increases of 60-100% in exam performance as a result of a very specific application of networked PCs) encouraged my university to put venture capital into a computer based education (CBE) pilot project in physics. In the space of a few years, the pilot project has grown into a service used by thousands of students in around one hundred subjects. As an example, in 1992, 17,000 QUT students used 150,000 hours of CBE, and answered three million CBE screen-based questions.

THE QUT CBE APPROACH

The approach used at QUT to the use of computers in education is based largely on applying question-and-answer techniques to learning facilitation (as opposed to testing), and is a derivative of the Socratic dialog method. Socrates' students learned by working out answers to questions posed to them by their teacher; Socratic dialog is 'leading out' or eliciting a response based on the knowledge already in the student. The QUT approach allows for the probability that the student may not know enough to give a thoughtful answer, but can find

out by using existing learning resources such as texts, tutors, and other students. When applied to computers in learning, this approach has much to commend it when compared to using a computer screen to instruct a student ab initio:-

- the time taken to develop computer based question and answer material is much less than that taken to develop computer based instruction;
- the student is obliged to take an active role (consulting instructional resources in order to answer the question, sifting through information, and thinking through to the synthesis of an answer), which generates more effective learning and greater interest from the student;
- in this instance, Socratic method leverages existing instructional resources. One of the difficulties for students in learning is the problem of knowing how most effectively to use texts, tutors, lecture notes, peers and so on for learning purposes. Well designed computer-based questions can provide an effective, interactive learning guide. Many of today's students have difficulties learning by reading when the reading is not aimed at responding to specific questions.

In 1990, the Department of Employment, Education and Training of the Australian Commonwealth Government commissioned an evaluative study into the impact of CBE on QUT. The study reveals an extraordinarily positive response from students and staff of the university to the use of computer based education as practised at QUT. Interestingly, the approach adopted by the Government nominees on the study's steering committee was not aimed at "proving" that CBE is effective; they regarded that question as proven beyond doubt. Rather, they were interested in obtaining a recipe, a description of how and why CBE had grown and taken root at QUT, with the aim of enabling other institutions to follow suit without repeating the learning curve.

Of particular interest to this presentation are the factors influencing the successful introduction of CBE at QUT. The following extracts from the study are published with the permission of the Commonwealth of Australia. 'Several overlapping factors contributed to the original decision to trial computer based education at QUT in 1986. These included...the desire to explore technological solutions to the growing problem of large class sizes, and a perception that as an institute of technology, QUT should be at the forefront of the struggle to incorporate technology into teaching and learning. Many of these factors were based on financial considerations; increasing student numbers and escalating lecturing salaries meant that Australian universities were under pressure to become more efficient and effective in using the taxpayers' dollars to produce graduates; productivity became an increasingly recurring theme, both institutionally and nationally.'

'At the same time, the PC revolution was underway, with more computing power, more data storage and better display devices becoming more easily available at a lower cost in shorter and shorter time periods. With salary costs rising and PC technology costs falling at an unprecedented rate, good sense suggested that it was time to develop new approaches.'

'IN THE USA'

Corporations and the Armed Forces have moved most rapidly to exploit the advantages of new instructional technology. This is due in part to a different [from education] style of management, and in part to the fact that since these organisations pay salaries of both students and teachers, they are as interested in the productivity of a student's time as the productivity of the teacher's time.

In most (educational) settings...the perceived cost of a student's time is zero. Organizations that pay the salaries of both teachers and students appear to be far more likely to investigate innovations in teaching techniques than those for whom the cost of a student's time is zero.

...Interviews with 218 large US companies have found that 60 percent of these firms have made significant changes in training methods and training technology in the past decade. They reported extensive use of television, computers, live videotape playback, and satellite television networks. The Defense Department has also invested heavily in advanced instructional technology.'

'This raises a number of points:

- firstly, it is indeed the productivity of the student rather than the lecturer on which universities must focus in their educational roles, since good learning outcomes are the final goal. Learning requires a change in the learner, a change that can be facilitated in a number of ways (but finally demanding more of the learner than passive reception of external stimuli);
- secondly, if the focus is on the performance of the learner rather than the teacher, spending money on 'learning facilitation technology' makes sense, as has clearly been recognised by business, industry and the military in the United States;
- thirdly, the notion that the cost of a student's time is zero needs to be put right. While studying, students are consumers of resources, rather than producers (by and large). National self-interest dictates that

university students should graduate as soon as possible, as well equipped as possible to become productive members of society (notwithstanding difficulties in finding appropriate employment in periods of recession).'

'The four-year study by the US Congress Office of Technology Assessment quoted earlier was the basis for a more succinct commentary by the Hudson Institute. This commentary is a strong indictment of America's education industry, nominating education as having the worst productivity record of any major American industry.

...holding institutions accountable for actual knowledge and skills gained by students, and revising employment practices to reward competence and flexibility - promise to create an environment where instructional efficiency matters.

...the key obstacle thwarting America's shift to an information-age economy is the egregiously poor productivity of the education sector. OTA found that education is tied (with social work) as the most labor-intensive business in the economy, with labor costs equal to 93 percent of output value - compared with 54 percent for all private business.

Since 1950, the real-dollar (inflation-adjusted) cost of elementary/secondary education in the United States has quadrupled...price tag for higher education doubled in the past ten years, rising far faster than inflation...education has by far the lowest level of capital investment (another name for 'buying technology') of any major industry; only about $1,000 per employee. The average for the US economy as a whole is about $50,000 of capital investment per job; in some high-tech industries, it's $300,000 or more.

While these words were written some years after the QUT CBE project began, they capture the thinking behind the project so well that such observations might have been the basis for the project.'

'It is against this broad backdrop of focus on the learner's productivity, attempts at cost containment, a desire to find effective ways to invest capital in productivity-enhancing technological innovation, and concern with rising class sizes and related quality issues that the decision by QUT management to speculate a small sum on a pilot project in computer based education should be viewed.'

'In hindsight, the crucial choices necessary for success had all been made by this stage; the question-and-answer approach...; the decision to use a network with a file server so that learning materials would only need to be placed or updated in one location; the happy choice of Novell Netware, which at that stage was anything but a safe bet; placement of the delivery system in the Library, a central location on campus; the lucky choice of a well-supported and useful authoring system; and the decision to go with IBM PC compatibles (as opposed to a mainframe and terminals), meaning expansion and upgrading could be done at any time in small increments of hardware and cost. Strong support from top management, and the compactness of the QIT campus [in that students could quickly reach the one CBE lab available at that time from anywhere on campus] were also prerequisites for success.'

'The question-and-answer approach (or Socratic method) was very clearly the right choice to make in a pilot CBE project. In 1985 there were very few tools available for rapid, low-cost development of quality computer based instructional material. On the other hand, excellent conventional instructional resources abound for the average student; texts, lecture notes, peers, tutors and the resources of a library provide many paths for effective instructional journeys. Computer-based question-and-answer materials can be developed quite cheaply, obliging students to use those resources effectively to answer the questions; while so doing, active engagement with the problem and material, often accompanied by arguments with peers over the correct answer, provides a powerful learning experience.'

THE LESSON

Some comments on the challenges posed earlier can be derived from experiences over the past eight years at QUT:

- almost invariably, if there are two ways of doing a thing, the simpler way is better;
- the engineering issues to do with the QUT CBE service - issues of delivery, simplicity and transparency of use, reliability, and the considerable difficulties of solving the technical problems of delivering large quantities of CBE materials to thousands of students over multiple networks - are much more difficult than issues to do with pedagogical design or choice of authoring systems. There are many ways of helping students learn by using computers, but there are few ways of delivering the material cheaply, reliably and automatically;
- enlisting top management support is imperative to the success of a CBE project; since successful CBE is an uncommon thing, management needs hard evidence of clear and limited objectives; that real problems or needs are being addressed; and that a clear, simple plan has been well thought out for strategic development, a plan that is owned by the user community;

- Whatever the project, its chances of success are immeasurably greater if it uses low-cost, widely available, industry standard technology, supported by multiple vendors and supported by the organisation in which you work;
- "value-added" services (such as making available off-the-shelf packages, word processors etc.) increase the chance of success;

In CBE, there are some universal laws:

- the more interactive the material, the more development time needed;
- the more sophisticated the structure (conditional branching etc.), the more development time needed;
- the more non-text (sophisticated) the material, the greater the development time;
- and many more.

However, there are also some laws which seem obvious, but do not hold up to scrutiny:-

- computer based education reduces the social interaction experienced by students; WRONG; a small group of three or four (or even two) students discussing the answer to a screen-based question is a common experience at QUT, and students are explicit in their enjoyment of the social interaction in CBE labs;
- CBE works best when it is exciting and stimulating; NOT NECESSARILY TRUE - it depends on the goals. In some cases the breathtaking experience may produce no retained learning;
- Multimedia is a good thing; NOT NECESSARILY TRUE - it depends on the goals. Sometimes a student can learn more from answering a bunch of text-based questions than s/he can from interacting with a multimedia extravaganza.

THE DISAPPEARED COMPUTER

I want to draw to your attention the use of technology in the classroom, as opposed to its use by students. One of the difficulties with using multi-media is the sophistication (and cost) of the equipment needed to present it in a lecture hall or classroom, and the associated difficulty lecturers have in using the display technology; in some cases, a three-year degree is needed to make the technology do one's bidding!

One example of technology assisting teachers is the 'smart' lecture theatre, which uses touch-screen technology to make it possible for lecturers to use a very wide range of display and computer technologies with just a few minutes training. Videodisk players controlled by bar-code wands mean that we can show slides or video during a lecture by wiping the wand over a photocopy of a bar-code in our lecture notes. Commodore's CD-TV and Philips' and Sony's CD-I players use compact disks with controllers just like those used to control TVs or videos. These machines are computers with extra bits added on. They don't look like computers; they look more like hi-fi equipment. They are examples of the 'disappeared computer', a programmable machine controlled not by a keyboard but by other means, often using displays other than the normal computer monitor.

The beauty of the disappeared computer is that it is child's play to operate. It has been changed from a truly multi-purpose device to one tuned to a narrower range of possibilities - a special-purpose computer which is easier to use than a PC. Such disappeared computers offer very real advantages in ease of use, and therefore have great potential for aiding a high proportion of the population to achieve more - and this includes those of us working in the education industry. For the moment, we still have to work mostly with those tricky little devils - PCs, terminals, Macs, and so on - machines with keyboards and mice and computer screens which can't show TV!

THE FINAL WORD...

I have tried to set the scene for the climax of the plot, where we wrestle with the promise and the challenge of multi-media in training and education. All of my experience over the past eight years inclines me to urge caution. On the one hand, I know that a training experience does not have to be exciting to be effective, and that it is much quicker and cheaper to develop (and deliver) text-based (rather than multi-media) CBE material. At the same time, motivation and interest are considerable factors in learning, and multi-media certainly can contribute to the students' interest. Conversely, the greater the multi-media content, the easier it is to ignore soundly based learning theory in favour of spectacle.

In the final analysis, I suspect that the manufacturers will determine the path taken by the 'technology in training' industry. The drive to have multi-media in the home has some very big players with some very strong arguments which are to do with entertainment. If they continue to invest in a major way in this particular money-spinning technology, very powerful, easy-to-use technology will soon be selling into the domestic market in large volumes, which means that the technology will sell for hundreds of dollars rather than thousands. The delivery medium for the content is here (CD-XXX) and very low in cost, and so I have to report that the battle is probably over already, unless the newer, emerging technologies such as PCS (Personal Communications Services),

including personalised electronic news delivered to your vest-pocket portable wireless computer; on-demand digital interactive cable TV, and so on - unless the electronic giants decide that the potential returns on these newer technologies are so great that they must pull the plug on CD-I-like development to finance the newer ventures and provide a focus for the consumer dollar.

Within three years, CD-I or something like it will probably be the delivery vehicle for training and education using technology. In some niche markets, videodisks will play a part, and in some applications, there will be a need to connect the CD-XXX players to networked fileservers, so that software can be updated and trainee responses gathered. Our job, as people with learning outcomes and costs in mind, is to try to ensure that considerable research is put into using the delivery technology effectively. And I suggest Socratic method will continue to be one of the most effective learning facilitation tools, whether we use multi-media, face-to-face teaching, or a simpler text-based approach.

SUMMARY

I promised to start a process of empowerment; to help you win support and funding for your multi-media projects, so let me summarise the steps I consider essential to success:

- define the need or problem (the organisation's, not yours), and make sure it can be treated with technology better than any other treatment. For example, technology is very good at keeping track of assessment scores, and of providing proof that training was delivered to person X at such and such a time on such and such a day. Being able to do that may be vital to your organisation;
- find success stories, and learn from them;
- be prepared to go through many months of writing submissions (it will seem like seven thousand) and talking to senior management about their perceptions of the organization's needs; do these things alternately, so that discussions inform your next submission;
- ensure that the project is clearly defined and limited in objectives, budget and time;
- use off-the-shelf training materials where possible, and beware of the NIH (not-invented-here) syndrome;
- use off-the-shelf technology of the same flavour as is already in your organisation if possible;
- deliver on your promises;
- make sure that the people you are doing this for actually want and commit to use what you propose;
- identify sources of funding, and give a broad-brush budget in your submissions;
- make sure evaluation is built in to your plan, and that the evaluation is reasonable - don't expect to be able to prove productivity gains, for example;
- don't be afraid to ask for help and advice from all sorts of strange sources;
- if you have problems, make sure management knows about them early.

And finally a news item which may be helpful. EDUCOM publishes EDUPAGE, a weekly news digest delivered electronically to your computer. In May 1993, the following item appeared in EDUPAGE: "The Chronicle of Higher Education has a story in its May 5 1993 edition about why there isn't more research done to demonstrate that instructional technology is effective in helping students learn. Some in higher education say campuses will be left behind if they wait for the research and others suggest that researchers have never been able to measure the effectiveness of textbooks or blackboards either."

This is about as far as we can go in this address; the end of the line is in sight. Multi-media has a great future. Right now, it is doing useful things in some areas of training; it is beginning to generate new ways of doing business, and it is still a relative unknown in the formal education system. The giants of the technology sector are investing huge sums in its future. Watch for the emergence of the multi-media equivalent of the CD-player or audio cassette player; that will be the key delivery platform for education and training.

GENERAL SESSIONS

General Sessions

Thursday

1.

Lee Olsen, PhD., IBM
Thursday, July 29, 8:00 - 9:30 am

Interest in multimedia has exploded in the last few years and the potential is limited only by one's imagination. At this session, you'll see what IBM's view of multimedia is...and how it's sphere of influence includes business, home, and schools. See multimedia in action as the influence of multimedia technology begins to permeate all aspects of our lives.

2.

David Ross, Georgia Southern University Industrial Technology Depar
Jim Taylor, University of Southern Queensland Distance Education C
And Directly From Toowoomba, Australia:
David Grant, University of Southern Queensland Distance Education
Thursday, July 29, 5:00 pm

Witness a presentation/demonstration from within the room and halfway arour general session. Presenters in Savannah and in Australia will discuss a systematic appro developing, and producing self-paced, multimedia industrial training packages.

You'll see in action the role of the Distance Education Centers in industrial trai audiographic equipment as a delivery system.

The audiographic equipment is supplied by Optel of New York, and it is an MS media workstation able to capture, store, transmit and retrieve high resolution graphic screens from a variety of input devices. The equipment communicates over standard te

Friday

3.

Breck DeWitt, Apple Computer, Corporate Briefing Center
Friday, July 30, 8:00 - 9:30 am

What might the convergence of the computing, communication, content and industries (C-4) do to help manage the information overload we deal with in today's s paradigm for conveying information is introduced, from print to film to telephones to and now computers, the result has always been an increase in the amount of informati individual.

How can the use of interactive multimedia and digital technology simplify acce mation while conveying it through the most appropriate media? This segment will exp trends in these industries and the growth in the use of interactive media as we strive to in human expression and communications in the information age.

Saturday

4.

FEATURED KEYNOTE SPEAKER
H. Dan Ellis, Ph.D.,
Queensland University of Technology, Australia
Saturday, July 31, 9:00 - 10:30 am

Most industries have been highly successful in raising productivity by capital investment in computer technology—but not the education industry. Will multimedia make the difference? What is it about multimedia that has people excited? Is there a way to use sound, video, graphics, animation, text, and some the other more exotic media (motion, smell, virtual reality, taste, touch) in simulations, in total sensory immersion, or in other ways to flavor the experience in a way that produces low-cost, hi retention, certifiable learning?

Ask and answer some of these and other intriguing questions in this session. Star process of empowerment which will help you enlist enthusiastic management support a tive multimedia-based learning and training projects- Find a way to deliver on your pro management becomes eager to thrust more money your way!

PAPER INDEX

CRITICAL THINKING IN THE MULTIMEDIA, SELF-PACED ENGLISH CLASSROOM

Lee Ann Mortensen

The words "critical thinking" have become a virtual cliché in educational writing over the last few years, and yet this higher level of thinking our students must do is not as simply broken down, taught, or written about as some would suggest. To think critically, to be able to analyze, synthesize, evaluate, and interpret essays, literature, and culture, is constantly stressed in college composition courses as well as in literature courses (Braswell 65). But the art of teaching these elements, if they can even be broken down into elements at all, is difficult at best. With a generation of media fed students facing English teachers, this difficulty is increased. How does an instructor convey even the so called basics of critical thinking to students who receive daily feedings of unquestioned and unevaluated media input?

For some instructors, multimedia innovation becomes useful when faced with these challenges. Customized multimedia learning modules not only help students to evaluate and analyze what they find within media and culture, they can also help keep students interactively interested in a medium of communication they have sometimes been taught to yawn at the written word. For many general education students, words seem to merely sit in front of them on a static page. When text and multimedia are combined in creative ways to enliven critical thinking ideologies, beginning students can more thoroughly practice their instructor's pet way of thinking at their own pace, as well as prepare to later interact with other students in class or via electronic mail.

The combination of multimedia and critical thinking theories become even more vital in a self-paced environment where students are basically on their own. As courses fill quickly with diverse student populations who either find traditional English courses too slow, or who have restricted schedules (Joncas "Teaching" 14), self-paced classrooms at the undergraduate level are becoming more common in both literature as well as composition. This then requires more explicit, more visual, and more interactive pedagogical responses.

As a feminist, a post-structuralist, a researcher, a budding tech-head, and a novelist, I know that what I want to help my students focus on must be tinged with my own theoretical and creative ideologies. According to most post-structuralist theories, one's beliefs will always be part of what is being taught, even if subdued. Because there are so many different critical thinking ideologies being used to explain so many different kinds of culture and literature, it becomes impossible for most instructors to find their kind of multimedia module for sale in a software catalogue. True, there are many composition products on the market, but most seem to be for children. In literature, there are adult products available, like the very effective and interactive Illuminated Books by IBM. These, however, focus on only the most famous canonical sources, thus excluding much of contemporary culture, thought, and writing.

A possible solution to this commercial lag comes, for some, in the form of do-it-yourself authoring packages where teacher individuality, choice, and control are, for the most part, supreme. What I will concentrate on here are the benefits, the problems, and some examples of the authoring software Multimedia Toolbook for Windows used to create critical thinking modules for self-paced courses in both composition and literature.

With all of the many authoring packages available like Authorware and IconAuthor, both of which offer easy-to-use icon-based programming, I chose Multimedia Toolbook to help develop critical interactive modules on logic in composition as well as on women's literature. Any of these systems would allow me to combine the examples, exercises, ideas and texts I've enjoyed using in the past, with the sound, animation, photos and video I think will best enhance what I already have. Toolbook, however, was much less expensive than most authoring software, offered more in-depth, on-line tutorials and application examples for beginners to paste and cut from, and also allowed for free runtime distribution rights in case I later found others interested in using my critical modules (DeVoney 386).

Those who have worked on a new piece of software without having a class to get them started, are familiar with the frustration and difficulty involved in learning a new system, especially an authoring package. Though most of this kind of software is simpler and more flexible to use than a programming language like Visual Basic, there is still a great deal of time involved in learning a program like Multimedia Toolbook. Some campuses, like Northern Arizona State University, solve this problem by having teachers collaborate with programmers, which saves time, but costs money. This is a luxurious situation lets the faculty member write out details of where and how to introduce the learning module, what examples, photos, quizzes or tests to include, and the animation or sound desired. The programmer, a faculty member or technician from the computer sciences department, then makes the module come to life, helps the instructor polish concepts, and fixes the bugs that inevitably pop up.

This wonderful collaboration between faculty and programmers is not always possible at the community college level, however, due to a frequent lack of funding or staff. In that case, the instructor who is daring, or desperate for customized learning modules, must take on a what ends up being the equivalent of a summer job as she learns how to use the product and work with its language (like Open Script in Toolbook), how to organize her critical thinking concepts and make them explicit in the software, how to buy and then work hardware like CD-ROM drives, video capture and sound cards, scanners, and VCR equipment, and how to export and import all of these additions into her Toolbook application. To many, this is a daunting project. However, if the instructor can do it, the dividends are rich.

A self-paced course in composition has students meet at the beginning of the semester in an English computer lab where all the equipment (networked 386 machines, CD-ROM drives, laserdisk players, earphones) and software (either on floppy or hard disks) is available during open lab hours or by phone through multiple line modems. The students are given a course orientation, which can be in the form of an on-line module familiarizing them with general systems, or in the form of a packet containing detailed syllabi, assignments, and written software tutorials for electronic mail, word processing, and the multimedia modules which they will complete.

One general advantage of the multimedia classroom is that students can use electronic mail to respond at their own speed to the readings in their texts and to others responses to the readings. This gives many of the students more interaction with each other than they might get in a traditional classroom where only a few have the chance to speak (Cooper and Selfe 848).

Another advantage of the multimedia environment is the learning module created by the instructor. Not only can readings be made more vivid, understandable, and individualized with sound, photos, video, and hot words, but the instructor can also add rhetorical modes, readings, samples, and critiques not offered in the textbook. Going a step further, the instructor who is involved in portfolio based courses can design modules that have nothing to do with rhetorical modes or with professional readings. These kinds of modules can focus entirely on student writings, collaborations, critiques, and revisions, all of which can be created and modeled with an authoring package like Toolbook.

A text like Joncas's High-Tech 101: A Self-Paced Composition Course, which is used for computerized composition at places like Glendale Community College in Arizona, and Utah Valley Community College, contains most of what a student needs to get through the basic rhetorical modes, including short explanations, evaluation sheets, peer critique sheets, reaction questions for electronic mail responses to the readings, and professional and student essays. The one ingredient missing from this is the instructor who enhances, models, explains, and comments on what is in the book, and facilitates discussions and critiques about the readings. Multimedia Toolbook can fill this gap nicely.

For example, the chapter from this text that deals with logic, or critical thinking as the author calls it, contains an introductory reading about logical fallacies which defines and gives examples of heinous hasty generalizations, ad hominem, non sequitur, and bandwagoning, among others. The chapter also contains readings about the scientific method, and two essays that argue logically, and illogically, about beliefs in God. Putting this chapter into a self-paced learning module is most effective, even if an instructor chooses to add only simple multimedia additions. Still, an instructor can add more examples and analysis at any time.

The students come in during open lab hours and start the logic module by either clicking on the appropriate Windows icon which leads to the file server, or by checking out a floppy disk. The first screen, or page, the student sees is the introduction, which starts with an audio clip of the instructor introducing logical fallacies as animated words move around on the screen. Everything freezes and the student is asked to click on the "Logical Fallacies" word itself, a hotword that leads to a definition screen. Or the student can click on the logical fallacy they are most interested in learning more about. For example, they might click on "Bandwagon Fallacies" and jump to a page which shows a picture of a pair of platform shoes, currently a "new" fashion. The student is instructed to click on the still shot of the instructor, which animates the picture and opens a dialogue box of text:

> *Just because every one of your friends is wearing platforms this summer doesn't mean these kinds of shoes are beautiful or safe. But when your friends make you feel stupid because your shoes are flat, they are using the logical fallacy called Bandwaging.*

At that point, the student is instructed to click on the button called "Shopping," which takes them to a screen of a short video clip of the Home Shopping Network in full, bandwagoning swing. Future buttons can lead to other students commenting on these popular culture examples. Or the student can click on buttons that lead to examples from the text that illustrate this fallacy. Eventually, student gets to screens that ask analytical questions about why various new examples illustrate bandwagoning. If the student isn't sure, they can click on a button called "Answers" to get help. At any time the student can click on a button with a question mark on it and get to a screen where numerous questions are listed. Clicking on any question will lead to an answer. If the student wants to ask another type of question, they can click on a button to open a word processing screen, type in their question, save it, and

send it to the instructor via electronic mail. Eventually, the complexity increases as the student must decide which among many examples is bandwagoning and explain their choices.

Multimedia Toolbook allows the student to go at his or her own pace in a non-linear fashion. For example, the student could choose to skip some of the more obvious examples of bandwagoning and go right to the places where they must respond, and respond correctly. In either case, the Toolbook format requires the student to actively navigate many buttons and messages, which helps the student remember more than they would with a traditional text (Bernhardt 156).

In the world of literature courses, much of the software available is centered on canonical texts and authors, which means that many worthy texts are excluded. This is especially the case for women's literature and feminist criticism, which is seldom, if ever, included in text-based anthologies let alone in multimedia packages.

A module dealing with these less common subjects can include anything, which is the beauty of the authoring process. In a self-paced women's literature course, the student can check out modules from the classics or from contemporary works. For example, they could choose the module Feminism, Bush, and Writing in the 80's.

The first screen opens with the title and two short video clips sitting side by side. One is of a women's march on capital hill, the other is of Dan Quail speaking. Certainly, this is overly didactic, but it brings the political contrasts of the 80's quickly into focus. The instructor's voice then introduces the module with more context for the analysis to follow. This voice can then direct the students to click on one of the video clips to get more historical details on each side, to look at pictures of famous people of the decade, hear speeches, and read short writing from popular magazines like Newsweek or The National Review.

At any time the student can click on a hot word they may not know, or they can go back to the introductory screen. There they will find buttons leading to Kate Braverman, a lyrical novelist, Colleen McElroy, a realist poet, Sandra McPherson, an imagistic poet, and Amy Tan, a realist novelist. If they click on "Kate Braverman," they will be taken to a screen that shows her picture. If the student clicks on a button, a dialogue box of text will appear as a selection of the author's prose is read in an audio file (either by the author herself, or by the instructor).

In this City of the Angels, you can trust nothing, not even the dense and erratic air. There is La Migra, la policía. Fire in the hills. Ash that falls from the skies. In this City of the Angels, en Nuestra Señora la Reina de los Angeles, it is best to be silent, invisible. (Braverman 9)

The student can then click on a button to get biographical detail about Braverman, or they can click on to get general student or instructor comments about the passage above. The student audio file might point out that this introduction sounds like a warning. The instructor might point out that there is a lyrical, or poetic quality to the repetition of "In this City of the Angels."

The student can write responses to other comments, or she can go directly to a third button called "Theory," which leads to the main theories, glossed over in a book by Pauline Palmer. These theories include "Patriarchal marginalization of women" (19), "women as receptacles," "or women as evil" (106). The student might click on the "marginalization" button, and go to a page where Palmer, in the form of pictures and instructor or actor audio clips, discusses the way a book by Angela Carter erases femininity by only focusing on the negative. The instructor can then start asking the student questions: "Does Braverman's segment erase women in any way?" The student can answer these questions, or can click on a button for modeled answers. As the module progresses, the student will eventually be required to select sections of new text on the screen and explain how marginalize or don't.

I have given a quick look into the ways multimedia can work to enhance and customize the instruction of critical thinking in specific areas of composition and literature. Because of the complexity and diversity of critical thinking theories, individually authored learning modules are one of the best ways instructors can take advantage of their own personal belief systems, and allow students to gain more memorable experience with various thought, culture, and writing.

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COMPUTER ASSISTED INSTRUCTION

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Educational and scientific technologies are advancing at an incredible rate. Ten years ago computers were still new and foreign to most of us. Today, I am composing this paper on my own PC with a fancy word processing program. Five years ago FAX machines were practically nonexistent, but today they are to be found in most businesses rather large or small. The same applies to paging devices and cellular phones. We are definitely becoming a technological culture with such innovations as: VCR, Video Discs and Music Discs that are laser read, large screen television and sophisticated home entertainment centers, home security systems that also control home lighting systems and contain "smart wiring" to receive future innovations. It seems that we are riding on an exponential growth curve in technology that is reaching the explosive growth stage. We produce so much electronic data and information we could literally bury ourselves. It is impossible to keep track of it all and stay one step ahead of obsolescence. I call it "techno-culture shock" and it all began with the innovation of microcircuitry and the silicon computer chip.

As educators, we could just throw up our hands in surrender or pretend technology will just go away. Instead we need to take a serious look at educational technologies and systems and begin, on an institution wide basis, to strategically plan for their use and control. First we need to find out what technological systems are currently being used and identify the benefits, drawbacks or problems, and issues surrounding these systems. This is only one piece of the strategic planning process and is admittedly way down the list in how to develop a strategic plan. However for the sake of relevance and brevity it is this "tactical planning piece" of the process that will be used as we look at CAI or Computer Assisted Instruction.

CAI (COMPUTER ASSISTED INSTRUCTION)

What is it? Computer Assisted Instruction known in the computer tech world as CAI has been the dominant force in educational computing for years. Before 1980 CAI was just used as an audio visual aid to instruction and was quite often just an automatic page turner for books on screen and was used to automatically grade computer designed tests. After 1980 with the advent of the Personal Computer or PC, CAI has become more of a stand alone teaching tool including tutorials, demonstrations, computer literacy training and simulation. (Coburn, 1985, p. 20)

CAI is now being coupled with real time on screen video sequencing to allow more personal teacher input. Currently there is a trend to make CAI more interactive with the student and encourage higher level thinking skills beyond wrote instruction or fact memory. (Dede, 1992, p.54) CAI courses are now being produced that can replace the instructor at the podium and still motivate or stimulate learning.

PLANNING CONSIDERATIONS

There are literally hundreds of CAI programs available covering scores of topics. In planning CAI, look for programs that have been on the market for at least a year. Versions 1 or 1.5 of a program are usually new and have a few bugs that need to be worked out with users' and developers' suggestions in field and laboratory tests. (Reeves, 1992, p.49) Get versions 2.0 or above in any CAI.

Check for compatibility with your computer hardware system. Most CAI's will run on a 286 chip that is keyboard driven with an EGA monitor. However newer more powerful programs may require a 386 chip or above, (more memory) be mouse driven, and require a VGA monitor (Higher monitor resolution). Compatibility may be a real problem requiring expensive hardware (machine) upgrades. Make room in your financial plans for projected upgrades, you will need them.

It is worth looking into a master lease arrangement for your computer hardware needs. Computer hardware quickly becomes obsolete requiring large outlays for upgrading. You can negotiate a good lease arrangement to allow for system upgrades and future purchase options. Pay careful attention to your lease payments. If you default on one section of the lease, the entire master lease goes into default. (Bryce, 1991, pp. 260, 475, 586)

You may decide to author your own CAI in house. In this case you will want to check out CAI Authoring Programs that allow you to create your own images, text, tests, and monitor student progress. These programs produce stand alone student disks requiring very little if any peripherals unless you want to use on screen video sequences requiring a CD-Rom (laser disc) reader or video deck. You also may need a sound card for audio. With a good tutorial program and about a month's use anyone who is at all computer literate can begin authoring good CAI courses.

I design CAI at Ft. Eustis and have found several good authoring systems. One is called "Ten-Core Producer" version 2.0 and the other is called "Quest" 3.0 or 4.0. Quest seems to be the most versatile across the board confirmed by a 1991 US Navy survey which rated Quest number one. CAI authoring requires good planning between departments. A team needs to be developed consisting of educators and subject matter experts to plan the course, computer graphics artists to do imaging and animation sequences, technicians to input the program, and a backup programmer to help with special computer problems or computer language needs.

Funding considerations are paramount to the success of CAI programs. In earlier years, the government was generous in its support of educational technology. Now in light of a tight economy and budget cuts you will have to get more creative in your financing. (Keller, 1983) There is an increasing trend for institutions to partner with businesses in the support of educational technologies. Handled carefully to protect your institution's tax exempt status, both industry and the institution may benefit. Grant money is hard to find but it is still available. Also consider forming an endowment to support your efforts.

There is an increasing trend among colleges and universities to form partnership arrangements with the business community and industry, especially concerning research that is technology based. (Keller, 1983) Financially these arrangements can be quite beneficial to the university in providing new capital for the purchase of special hardware and software. If the partnerships are carefully planned they can truly be a win, win situation in which the institution and the industry or business partner benefit. George Low, former deputy director of NASA, and president of RPI said, "technological improvement leads to economic growth." (Keller, 1983, p. 81) Funding research is good business for the corporate community.

However you need to proceed cautiously realizing that businesses are profit driven and colleges and universities are primarily non-profit institutions. Often a business is interested in partnering with an institution to develop research aimed at producing a new "product" that can be profitably marketed rather than just general "scholarly" research. Your planning team will have to answer some fundamental questions. Who will own the research when you are completed? Who will own the equipment and will it stay at your institution? Will there be royalties coming to the university from products developed? (This is a good source of future income). Will the business share employees with you who are expert in development? (This approach gives real tax benefits to the business who shares the employee). Also you need a lawyer to draw up the contract who is skilled in partnerships and will safeguard the institution's tax-exempt status. (Bryce, 1991, pp. 211-218)

RESEARCH

CAI in one form or another has been around since the introduction of computers into the school environment about fifteen years ago. There has now been sufficient time to conduct and document sound educational research concerning CAI. The input of data on CAI gathered by the Institutional Research person at your institution is very important to the planning process. Research provides a sound basis for planning. Also, your IR person can keep you aware of trends in this area of educational technology.

Research has shown that students learn just as effectively and in some cases more effectively with CAI as with traditional classroom instruction. (Office of Technology Assessment, 101st Congress, 1989) How the CAI is structured though is very important. Try to find CAI's that motivate student inquiry and can receive student input. This will encourage manipulation of ideas by the student and inspire higher level thinking skills such as inquiry, analysis, and synthesis of new ideas from given ideas. (Helsel, 1992, p.38)

How testing is handled in the CAI is also important. A 1991 research experiment conducted by Doris Pridmore and James Klein at Arizona State University confirmed that students perform better on CAI tests that include student controlled elaboration feedback on responses ("Would you like more information on this topic?") as opposed to CAI tests that just give student controlled verification feedback ("Your response is correct or incorrect.") (Pridmore, Klein, 1992)

This research has important implications in regard to planning and designing a CAI course. Currently I am producing a CAI course along with a colleague at Ft. Eustis. Early in the planning phase the subject came up about student feedback. We both felt that student controlled elaboration feedback would be helpful to the student. Our superiors questioned our elaboration techniques until I found this bit of research. Our CAI now contains a combined system of student controlled elaboration and verification feedback. Research works.

THE FUTURE FOR CAI

CAI is truly the old workhorse of educational technology. Unlike the horse however who was ultimately replaced by machines, CAI is continuing to be developed and adapted to merge with new technologies and become more effective as a teaching tool. The foundation of CAI is the personal computer or PC and will continue to be so for

quite some time in the future. However there are now new peripherals to enhance the effectiveness of computer based instruction. With CD-Rom readers which bring in live action video sequencing through laser CD's, special three dimensional (CAD) image programs and sound cards added to a 386 PC, CAI can minister to almost any learning style. (Dede, 1992) This includes visual, auditory and tactile areas bringing in a full spectrum of experience to the student. Also these new techniques are allowing students, for the first time, to control and manipulate inputs and inquiry. This offers the student an opportunity to become more of an active participant and control his or her learning experience. This was not possible in CAI programs five years ago.

In 1956 only four American universities had computers. By 1964 this number had jumped to 500. (Ewing, The Time Dimension, p.445) In the next five years it is estimated that there will be over four hundred million personal computers in operation compared to about forty million currently in operation. (Comsell Report, 1992) Personal computers are now becoming as common as television sets. With the improving computer modems which transfer PC information through phone lines, microwave and satellite networks which can be downlinked to your home computer, and video/audio laser disc technology, I envision the PC becoming a personal information and international communication center right in the privacy of your own home.

With new generation CAI programs you will be able to take college courses at home and through distance satellite networks have the instructor come live into your home for special instruction. (Keller, 1983 p.19) You would have access to any experts who participate in your communication network whether local or international and bring them "live" onto your computer screen. You will be able to transfer papers, research and questions directly to your instructor through modem or satellite hookup with two way built in video. Higher Education programs will become more and more interdisciplinary as students begin to have the ability to tailor their educational programs to meet their own needs and areas of interest or expertise. You will receive the best education possible by interacting with the experts and scholars directly. Not only this but you will be able to save the transmissions in your computer's memory for future reference and build your own reference library. (Commonwealth of Virginia, The case for change. p.6)

I don't believe however that CAI will ever completely replace classroom instruction as we currently know it, at least in our lifetime. My generation is still tied to "the stubby pencil and paper" system which has a text base and relies on the brain's ability to receive and process about 100 bits of written material per second.

However, there is a new generation of students who have been raised on the visual world of video and MTV who rely on visual imaging and "icon" or symbol based learning. This "visual generation" is being schooled on the brain's incredible ability to receive and process over one billion bits of visual information. (Helsel, 1992, p.42) It is no wonder these kids like everything high paced and action packed! Computer use is second nature to most nine year olds now, (including my daughter) not to mention junior high and high school students. This is producing a "visual revolution" that will change the way we teach. Will we be able to afford to retrain current teachers to function within this technological and visual revolution? Also will faculty members resist being retrained in light of the continued "graying" of academe?

In light of declining resources it may be necessary to phase the old system out while phasing in the new system. (Berquist, 1992, p.81)

CONCLUSIONS

In conclusion, CAI is a powerful technology that is getting more and more sophisticated and flexible in its use. With the advent of laser and satellite technologies, the real possibility of having international information and communication centers right in the privacy of our own homes is on the horizon. These technologies are amazing tools that can bring instruction and information from a far, but we must always keep in mind that these machines and technologies are to be our servants and not we theirs.

Machines can be very dehumanizing to the user because they do not possess the human qualities of warmth and compassion. Although computers can be programmed to mimic human thought processes and other human qualities, they will never be "human" in the full sense of the word. Despite their speed, computers are not human brains and they do not think like humans. We must not devalue the necessity of the human element in working with computers. How the programmer designs the CAI is vitally important. Computers are fallible because the human programmers are fallible. At this point in time computers are not able to program themselves and depend on a human programmer to create the programs. I emphasize however-AT THIS POINT!

From a cultural perspective there are many in our society who are unaccustomed to the use of computers and are naturally leery of them. The perspective of these folks is an important cultural bridge to the new age of technology and must not be ignored. We all need to keep a degree of caution in computer use and not become so dependent on them that we become their extensions. Also we must make provision in our plans for training computer technicians who can repair these miraculous machines when they break down so we will not be "dead

in the water" and unable to function. Computers do break down and repairing them is expensive! Be sure to have a good maintenance agreement in your hardware contract.

I am not convinced that we are culturally, legally, or ethically able to handle the issues that are rising, and will yet arise, out of the exploding pace of scientific and educational technologies. The legal system is already being stretched to the limit and beyond in deciding such issues as: Who has custody of the sperm in a sperm bank in a divorce case? Who has the authority to pull the plug on life sustaining machines keeping a comatose patient alive? (Eller, Reitzammer, 1990)

Current multi-media technologies are beginning to be merged into hypertechnologies that have the capability of producing artificial worlds and realities. The new technology is being labeled "Virtual Reality" and allows the user to function in, manipulate, and "feel" objects in a computer produced environment that is not really there. (Helsel, 1992) This technology is already available for use on personal computers and opens up a whole new dimension in CAI use. Rather than just read about Abraham Lincoln, a student could meet him and relate to him, or be present at the Gettysburg address. But who decides what the computer generated Lincoln will say? What effect will this have on a student's permanent perception of history and reality? These are difficult questions. The new generation of CAI could be the greatest innovation to educational training since the printing press. In the wrong hands however it could be the worst propaganda tool ever invented. Imagine if the president of the United States was kidnapped and placed in a virtual environment where he became convinced that the U.S. was under foreign nuclear attack and gave a "real" order to fire from our nuclear arsenal bringing an international holocaust. CAI based artificial realities could also be turned into the ultimate pornography with its multi-sensory approach. Future CAI development may be the door to an educational revolution or Pandora's box. (Dede, 1992, p.60) The choice is ours. Sound strategic planning now on this issue is vital to the future of higher education.

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CYBERTEACHING: TEACHING ABOUT AND WITHIN CYBERSPACE

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ABSTRACT

Cyberspace is an imaginary, computer-mediated, multi-dimensional space where more and more of our activities in the future will take place. Since even physical laws there may be different, conceptual understanding will require a cognitive model of cyberspace, better planning of our visits there, and navigational practice.

Some place where there isn't any trouble. . .
Do you suppose there is such a place, Toto? There must be. Its not a place you can get to by a boat or a train. Its far, far away. Behind the moon. Beyond the rain. Somewhere, over the rainbow. . .

- Dorothy in *The Wizard of Oz.*

WHAT IS VIRTUAL REALITY?

Though to some the term "virtual reality" seems oxymoronic, to others its essence connotes "almost reality" or "fake reality". In fact, virtuality may be temporal or spatial. Virtual space is often linked to one of the senses. Thus one might think of an acoustic (sound) space or a visual space or a kinesthetic (touch) space. Olfactory (smell) and gustatory (taste) spaces may also be possible. There may be a space for each of the senses. However, the more senses that are involved at once, the more *immersed* one may become in an artificial or virtual reality and the harder it may be to distinguish reality. Because the senses normally work together to channel input to the brain, manipulating all the sensory inputs fosters the perception of an alternate reality. The participant feels part of another world-a virtual world-and total immersion may occur. At present, only the computer holds the potential for dynamically controlling and synchronizing input to all the senses.

One might, then, define virtual reality as the complete computer control of the senses. Virtual reality becomes a way of sensing/feeling/thinking. By controlling the input to the senses, the computer controls sensation. This in turn affects experiencing and feeling, and ultimately thinking. New thoughts, perceptions, and ideas begin to emerge as a result of the modified sensory input.

WHAT IS CYBERSPACE?

Cyberspace may best be thought of as the sharing of two or more virtual realities. For example, if you were to play a video game in which your virtual puppet is a tiny character on the moon, that is virtual reality. But if another player's virtual puppet enters, shares, and interacts with yours in the same virtual space, the area containing the interaction is cyberspace.

Just as virtual reality is a way of sensing/feeling/thinking, so cyberspace becomes a way of communicating/participating/working. By entering the world of cyberspace, we can change how we communicate, how we participate and interact with one another, and how we work together. Again, new thoughts, perceptions, and ideas begin to emerge as a result of these cyberspace interactions.

EARLY EXAMPLES OF NON-COMPUTER CYBERSPACES

Though the concept of cyberspace today implies the use of a computer, most of us are already familiar with non-computer analogues of computer cyberspace. For example, the telephone illustrates acoustic cyberspace. Though generations of users thought of it only as a device to connect two people directly, the advent of conference calling forced us to reconsider the telephone as connecting us to an acoustic space: electronic facsimiles of our voices meet and interact in an acoustic cyberspace. Gordon Thompson used to complain that the telephone company distorted that space by introducing delay when satellites were used for long distance communication. His argument was that the delay distorted the message for which the telephone company could be held responsible (Thompson, 1982). Similarly, the advent of voice-mail is forcing us to add a temporal dimension to our acoustical cyberspace. These perceptual differences of the telephone are often reflected in the age of the users. Younger users tend to ask "is John here?" demonstrating their implicit recognition of an acoustical cyberspace.

OTHER SOUND SPACES

There are other kinds of acoustical cyberspaces which do not involve the telephone. The recent release of Natalie Cole singing with her late father, Nat King Cole, is an example. Though the two never sang many of the songs together in real life, today one can hear what such a duet would have sounded like had they actually performed it together. Here is a taste of artificial reality: we are listening to a recording of something that never actually took place.

One situation that was detectable and irritated viewers was the use of "canned" laughter on television situation comedies--shows that were taped without audiences had the laughter added later. Today's shows are often shot twice with different audiences present and spontaneous laughter is recorded. Though TV viewers are led to believe that they are seeing the same show that a live audience saw, they actually see a carefully edited version combining the best audience reactions. Thus TV viewers do not see the whole show as seen by either one of the two original audiences.

It was said that Elvis Presley found the words to the song "Are You Lonesome Tonight?" so funny, he burst out laughing during each recording session. Because of this, the version that was finally released had to be compiled from "pieces" of his various recording attempts. No studio recording exists of him singing the song through in its entirety.

Disco music is often built up in 15 or 20 audio layers and then put together to produce the final version. Thus it is not possible to listen to disco music as we know it, being recorded "live." It exists only piecemeal in the real world. Rock fans who complain about paying good money to see "live" concerts by famous artists (like Madonna) only to find that some of the music was recorded and the voices lip-synched, fail to understand that many of the musical special effects often cannot be created "live" for similar technical reasons.

VISUAL SPACES

Other examples of non-computer cyberspaces are motion picture cartoons. Predating regular motion pictures by many years, movie cartoons are an example of the bringing to life of characters through animation (Katz, 1979). One can't see Mickey Mouse in real life (save for an actor in costume) but one can see him in an animated cartoon. In that sense, animation technology becomes the "scope" for observing the character.

Hollywood studios have become incredibly ingenious in creating simulated scenery and special effects. Matte photography is an example. By carefully cropping pictures of scenic areas, whole films can be shot on a sound stage instead of on location. The use of mattes gives producers the possibility of building up scenes, layer by layer, in a way completely undetectable to the viewer, to recreate authentic backdrops from famous scenes in history. Many of these film compositions contain as many as 15 to 20 or more mattes or "layers" on which live action is imposed. The film "The Empire Strikes Back," for example, used as many as 38 mattes in some scenes. The studios were doubly ingenious to realize that the public was so fascinated with the technology that they would pay to see how it was done. So much so that creating movie theme parks where none existed before has turned into a profitable enterprise. (In Universal Studios Florida, patrons pay to see a building which is a replica of a building on the Universal Studios California lot which in turn is a replica of the real thing.)

In the video world, the buzz word is "retracking." Early examples of retracking appeared in the 1970s on the Cher television program where the star would appear in scenes without the audience being able to detect the "trick" photography. A number of new series are now being prepared in which the actors and actresses perform on a bare stage and are videotaped that way. Electronically, and with the help of miniatures, scenery is added to the videotape later. Many television specials now feature the same actors playing different parts, dressed in different costumes, interacting with themselves in a manner wholly undetectable to the human eye.

Hank Williams Jr. (born 1949) was only three years old when his father died, yet as an adult he recently made a videotape in which he appears to be singing with his late father, Hank Williams Sr. (1923-1953). To achieve this effect, producers took a videotape of Hank Williams Sr. singing a different song, slowed it down, replaced the sound track with the current song, and had Hank Jr. walk into the scene and sing and play the guitar with his late father (Bessman, 1989).

The Pepsi-Cola Company has been using similar techniques to promote their products in commercials. In one, dancer Paula Abdul, who was born 1962, dances with Gene Kelly. The Gene Kelly portion was shot some 50 years earlier, before Paula was even born.

WHY THINK ABOUT CYBERSPACE?

At precisely the time when the world is running short of space, and even reaching into outer space, the computer provides an exciting way of creating not only new space, but a new kind of space: cyberspace. It is analogous on the physical level to utilizing the space between molecules for storage. It represents the creation of more space, paradoxically without taking up more space. Increased communication and advanced technology ensure that more of our interaction in the future will take place in cyberspace. If more and more interaction takes place there, participants must become aware of the qualitative differences between cyberspace and real space. In cyberspace we can explore a myriad of alternate realities, examine new cultures, and develop new perspectives. We can test new concepts as foreign consumers and import these back to our own reality. Cyberspace offers the potential for participating while observing, traveling while staying put, animating the inanimate, breathing life into fantasy, giving form to the sublime, and crystallizing the imagination.

WHY TEACH ABOUT CYBERSPACE?

If, in the future, more interaction takes place in cyberspace, we will need to have a cognitive model of cyberspace to facilitate our navigation there. This need is akin to requiring a road map in a strange city. Without such a cognitive map, setting destination goals will be impossible and navigation will be both difficult and frustrating.

For these reasons, we need to organize and plan our visits to cyberspace. In the same way one might use a travel book as a guide in a foreign land, the cybernaut needs to learn the customs, rules, and conventions of cyberspace. Simple acts, like walking, may prove difficult or might be accomplished differently, and new skills, like flying, may have to be learned.

The acquisition of such skills requires more than just knowledge: it will take practice. Learning navigation as well as practicing navigation in cyberspace will be fundamental to successful operation there. Just as one might read a book on swimming, only practicing the strokes optimizes performance.

CHARACTERISTICS OF COMPUTER CYBERSPACES

Computer cyberspaces differ from other types of cyberspaces in that they are externally invisible, internally shared, and essentially nonlocal. Since cyberspace exists within a computer no one is sure exactly where it is: that is, one can't tell from looking at the outside of a computer what cyberspaces may be available inside. In fact, in today's world we may not even know where the host computer is. Cyberspace is shared, by definition, and since time and space become irrelevant dimensions, there is reason to believe that most cyberspace interactions will occur nonlocally.

CURRENT EXAMPLES OF COMPUTER CYBERSPACE

The potential of cyberspace is limited only by our imagination and one can visualize the eventual creation of three-dimensional, multisensory, immersive "holodecks" of the type envisioned on "Star Trek: the Next Generation." The creation of such technology is clearly the goal but until it materializes, we must try to understand the ways in which our current technology can contribute to our excursions in cyberspace. One such technology is the Internet (Kehoe, 1993; Krol, 1993; LaQuey, 1993).

THE INTERNET

The Internet is a vast, worldwide network of computer networks which best exemplifies the promise and potential of teaching and learning in cyberspace. Though still linear and textual, and not yet exhibiting the array of three-dimensional, multisensory characteristics that are eventually expected to evolve, the Internet is, nevertheless, the most powerful model of a virtual classroom, laboratory, and library in existence today. Its size is staggering: 13 million users (Lottor, 1993) linked interactively by hundreds of thousands of virtual machine hosts. Its evolution is exponential: projects such as the billion dollar National Research and Education Network (NREN) (Jouzaitis, 1993) and the Canadian Network for the Advancement of Research, Industry and Education (CANARIE) promise to expand use of the network to include kindergarten through secondary school levels (Silva & Cartwright, in press).

THE INTERNET AS A VIRTUAL CLASSROOM AND LABORATORY

One innovative and creative use of the Internet as a virtual classroom was made by Richard Smith at the University of Southwestern Louisiana and Jim Gerland at the University of Buffalo. Their workshop, "Navigating the Internet: An Interactive Workshop" was an attempt to teach Internet users how to exploit its resources optimally (Smith, 1993). Attendance hovered around 12,000 interactive users and the workshop was conducted entirely over the Internet. Although plans to make the workshop exclusively interactive were unsuccessful because of the number of participants, it stands as perhaps one of the most innovative, large scale uses of cyberspace to date.

Another promising use of the Internet as a virtual classroom is the U.S.-Russia Electronic Distance Education System (EDES). Over forty prominent schools and companies (e.g., Brown University, Dartmouth, University of Maryland, IBM, and Apple) have indicated their desire to participate in the project which will be conducted using telecommunication media (Utsumi, 1993).

EDES will be organized by Global University in the United States (GU/USA) and the Association of International Education (AIE) in Russia. The project will allow Russian students to enrol in educational courses offered at participating universities and attend them interactively via telecommunications. The plan is to lease a broadband video channel on the INTELSAT satellite so that Russian students with an inexpensive antenna will be able to attend classes "virtually" anywhere. Although the project will use telecommunication media other than those presently available through the Internet, it augurs well for the impact the Internet will have on curricula and educational objectives.

Lastly, the use of the Internet as cyberspace has filtered down to the K-12 level. KIDSLINK, an electronic forum where children are able to communicate via the Internet, links children from 46 countries. In turn, KIDSLINK is composed of several other virtual educational forums: KIDS-93 which attempts to join children in a dialogue of views concerning the desired future of the planet and KIDSCAFE which enables children to explore dialogue by letting them set the forum discussion.

What is notable about the evolution and use of cyberspace as an educational virtual space, is the lack of rigorous studies attempting to outline and understand the phenomenon. There is little knowledge of the psychological and pedagogical consequences of teaching and learning in cyberspace despite its continued exponential growth.

FREENETS

Of interest to educational researchers is the use of cyberspace by the general public. Literacy programs, general information courses, etc., are now possible through participation in Freenets. Basically, Freenets are publicly administered, community networks that encourage free use of the Internet. They are an outgrowth of the National Public Telecomputing Network (NPTN), a research project sponsored by Case Western Reserve University. The goal of NPTN is to ensure the provision of free, computerized services to the public at large. As a result, the public is able to find the latest legal and medical news, scan newspaper headlines, and send their political representatives their views on policy issues. In essence, a virtual "town square" has been fashioned in cyberspace where citizens may meet to discuss issues of mutual concern. There are several Freenets in operation, the Cleveland Freenet being perhaps the most well established (Silva & Cartwright, 1992). The possibilities for interactive courses on Freenets are promising. Health programs, civic courses, etc., could reach many millions of persons and allow them to interactively participate in programs at their leisure.

ELECTRONIC COMPUTER MEDIATED DISCUSSION GROUPS

An end result of participation in cyberspace is the linking together in virtual communities, of persons of like-minded interests and tastes. Today there exist hundreds of such communities (thousands if we include USENET--the world's largest collection of discussion groups) (Strangelove & Kovacs, 1992), defined by their interests rather than their geography. The myriad views and opinions and the number of participants is enormous. In fact, electronic discussion groups are rapidly surpassing other communication methods traditionally used to disseminate and share information.

Internet users are also able to choose between moderated and unmoderated groups. Though the quality of discussion is higher in moderated groups, the unmoderated groups more closely resemble real life discussion.

Such discussion groups may also be part of local classroom conferencing as an adjunct to traditional teaching. Space does not permit an extended discussion here but suffice it to say that local conferencing (i.e. having the members of a class participate in a computer conference among themselves) leads to a number of interesting observations extending beyond the nature and structure of the subject matter. These principally concern social

dynamics and the eventual emergence of a parallel form of communication (which is never mentioned in class) akin to an alternate reality.

TOOLS TO NAVIGATE IN CYBERSPACE

The most appropriate metaphor for resources held on the Internet is a vast, virtual, distributed library lacking a single catalogue that indexes, locates, and retrieves the needed information or material. For this reason, the creation of what are commonly called "resource discovery tools" has gained wide attention.

There are many resource discovery tools: Gophers, Wide Area Information Servers (WAIS), Archie, and VERONICA (Very Easy Rodent-Oriented Net-Wide Index to Computerized Archives). Resource discovery tools attempt essentially the same thing: the location and retrieval of required information. Moreover, they are designed to facilitate navigation in cyberspace; the indexing, locating, and retrieving of information becomes transparent to the user.

Gopher, created at the University of Minnesota and named after its mascot, is a powerful, information distribution system that allows someone in cyberspace the ability to locate services and resources. It is an intuitive, user-friendly, menu-driven front-end program for navigating the Internet.

VERONICA was designed to function in conjunction with gopher. Because of the exponential growth of "gopherspace", indexing and locating information was becoming both problematic and time consuming. VERONICA indexes most gopher-server menus in the entire gopherdom. But what makes VERONICA particularly powerful is that once the information or resource is located, the user is automatically linked to it, allowing it to be retrieved and read, etc.

Wide Area Information Servers (WAIS) have been described as an "electronic publishing software set which allows you to search out and retrieve multimedia information from databases anywhere in the world" (Lincoln & Kahle, 1992). In this manner, users are able to store or access multimedia information anywhere on any platform (i.e., UNIX, MAC, DOS). Also, users can navigate, locate, and retrieve resources with their preferred interface; there is no need to learn a new program or front-end.

Finally, ARCHIE, created by students at the McGill School of Computer Science, indexes resources which are held at electronic archive sites and are retrievable using the Internet protocol File Transfer Protocol (FTP). FTP allows a user to send binary or text files from a local host to a remote computer. Because of the phenomenal growth of electronic resources publicly available in cyberspace, it was time consuming and nearly impossible to locate needed materials. With ARCHIE, an easy-to-use index makes the task of locating the archive holding the required material a trivial task.

MAKING CYBERSPACE CONCRETE

Cyberspace, like any geographic destination, deserves attention and study in its own right. This may prove to be difficult since the geometry, physics, geography, and even the history of cyberspace may be both differential and variable. All the more reason why we need to talk about it, describe it, and devise new ways of teaching about it. One way to make the concept of cyberspace concrete is with the use of overhead projectors. Although any object placed on a single overhead projector stage is represented virtually on the screen, the use of two, superimposed projectors creates on the screen an artificial cyberspace which is no longer a representation of what is on either projector but is a composite of both. To this end, the screen scene is cyberspatial. Such an arrangement is useful to help students think and talk about cyberspace concretely. Still other teaching methods can be envisioned to make cyberspace more comprehensible and accessible.

THE FUTURE

President Bill Clinton was the first president to whom members of the public could write via the Internet (Sakkas, 1993). Those who do write in this medium form a particular community or subset of the population. New electronic highways of the future will link not only existing locales but will similarly define and create whole new communities. The creation of these new communities and the development of whole new constituencies implies massive changes in social and political participation including the eventual, total democratization of education and a shift toward participatory democracy. To educate people on how to travel to, and thrive in, these new virtual worlds, to teach them to luxuriate in previously inaccessible cultures, to help them explore and understand new alternate realities, and to show them how to indulge new perspectives, skills, and abilities learned on their cyberspace excursions--these are the tasks of tomorrow's cyberteacher.

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DEVELOPING A PROTOTYPE MULTIMEDIA LABORATORY

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ABSTRACT

In keeping with its mission statement and current research directions, the Department of Computer Science and Information Systems (CSIS) is currently developing a computer-based Multimedia laboratory. This lab will serve several purposes for the CSIS department, The College of Arts and Sciences (CAS), and The American University (TAU) including: facilitating the development of a university Multimedia lab by serving as a prototype for multimedia laboratory development, providing CSIS faculty and students with a research platform for computer-based multimedia systems development, and supporting the development of cutting-edge curricula in a number of units in CAS.

INTRODUCTION AND SCOPE

Successful development of computer-based multimedia is an interdisciplinary effort that has sweeping implications for change in computing, communications, training, education, design, and other areas where vision and sound are integral parts of the presentation of ideas.

Computer-based multimedia is a high-profile technology that is revolutionizing all aspects of broadcast and non-broadcast communication including human-computer interfaces, training, and education. Essentially, computer-based multimedia is the integration of computers and media devices (such as still and dynamic graphics, sound, text, and data transmission devices) to create presentations that take advantage of the power of all media simultaneously. A computer-based multimedia system transcends the limitations of traditional media and permits editing of graphic images and text, integration of information that is available on-line from information repositories, tailoring of media presentations for individuals rather than a homogenous audience, adjustment of timing variations to accommodate different speeds of perception, inclusion of artificial intelligence-based feedback mechanisms that discern differences in human usage of systems, and many other capabilities that have already been identified and will continue to emerge as systems evolve.

The CSIS Department, in keeping with its mission statement and research directions has developed a design for a computer-based multimedia laboratory. The laboratory described in this report is the first phase (prototype) of an anticipated multi-phase effort to develop computer-based multimedia capability at TAU and expand CSIS's current research efforts in human-computer interfaces and applications of artificial intelligence. It is interesting to note that some areas of artificial intelligence are showing important potential for contributing to developments in computer-based multimedia. In particular, the building of intelligent agents is an area of research with strong representation in CSIS.

Phase I will permit us to test out various configurations, equipment, and software. It will provide us with the necessary environment to develop some unique software that we have articulated for computer-based multimedia systems, and it will provide us with a platform that gives us the physical credentials to pursue further funding through research and consortium grants.

We have a developed a layered approach to illustrate where the various research and development efforts fit with respect to computer-based multimedia:

6. Multimedia Users
5. Multimedia Developers
4. Knowledge Integration Tools
3. Expert Systems
2. Multimedia Hardware
1. Intelligent Agents

At the core is the body of knowledge of applied artificial intelligence that supports construction of intelligent agents [Layer 1]. We will not go into much detail here about the nature of intelligent agents other than to say that these are autonomous entities that appear to exhibit intelligent behavior. Intelligent agents hold great promise in many areas of intelligent information systems such as distributed intelligent databases.

Above the first layer are software/hardware interfaces to computer-based multimedia hardware [Layer 2]. These interfaces are not well defined and are the subject of a great deal of research in computing. The computer-based multimedia hardware layer subsumes the configuration described in this proposal. However, the proposed prototype lab represents only a small subset of the repertoire of possible elements that could be included at this layer.

Two or more layers, consisting primarily of languages and tools, sit on top of the computer-based multimedia layer. Expert Systems is showing promise as a means of interfacing to computer-based multimedia and other software systems will evolve both commercially and as research topics.

Of primary interest to this proposal is the layer titled "Knowledge Integration Tools." This is an area of research and development that calls on interdisciplinary expertise from computing practitioners, graphics specialists, artificial intelligence experts, trainers, educators, media experts, and evaluators. At this time, we understand the problem we are trying to solve but not exactly how to go about solving it. How do we develop hardware, software, networking, communications, and information retrieval systems to permit multimedia presentation developers to construct computer-based multimedia presentations without their having to understand the technology of the platform they are using? That is, can we build computer-based multimedia systems that will permit developers to retrieve components from a repository attached to a wide area network, others from archived dynamic video, and others from still photographs or cassette tape? And, can we build such systems where the underlying technology is transparent to the developer?

Multimedia developers are the population of potential users of multimedia. The developers utilize the Knowledge Integration Tools to produce seamless, knowledge-based, multimedia presentations. If the layers below this layer are well defined and constructed, they will appear transparent to the developers.

Finally, there are the users of multimedia. This population consists of the people who will rely upon multimedia in order to understand a concept, engage in training, transmit information, or any other traditional information transfer process (or news ones yet to be conceived).

Phase I will permit faculty and students from CSIS and such TAU entities as Graphic Design, Communications, Education, and other units to use and develop cutting-edge technology. For CSIS, the multimedia lab is a workshop for experimenting with and developing software tools to be used by multimedia practitioners. For other units, this lab will permit practitioners to experiment with multimedia in their own fields and to develop new curricula around multimedia capabilities. Phase I will also allow us to evaluate devices and software so that we gain experience about how to configure a major multimedia lab housed in TAU's Computer Center. In discussions with the University Computing Center (UCC), it is clear that a public multimedia lab is a priority item for providing cutting-edge technology to students and faculty in all units.

Phase I provides some other advantages specific to CSIS. It will permit us to expand our research programs in such areas as Artificial Intelligence, Expert Systems, Virtual Reality, Human-Computer Interfaces, Software Engineering, and Intelligent Information Systems. With Phase I in place, we will be in position to request further funding from government agencies for faculty and student support and for additional, more expensive equipment. Phase I will permit us to run workshops for external audiences, to establish a reputation in the D.C. area around this new technology, and to pursue research funding in areas where multimedia can be applied (e.g., training, pre-college education, graphic design, virtual reality environments, etc.), and provide a research track for our students. Several graduate and undergraduate students are already involved in research (under independent study) into multimedia. They are, however, using some existing basic (i.e., low-level) outdated hardware and software that we have in the CSIS lab. With what we currently have, students are really using a minute subset of what is emerging in the field and they can merely get a taste for what the discipline is about.

EQUIPMENT REQUIREMENTS

This section contains the list of equipment that we feel is needed for a successful laboratory. Since the full complement of equipment is very expensive, it could be built up over time. We have discovered that several other computer labs on campus contain various bits and pieces of equipment that can be used. Those items that are available on other sites on campus will be the lowest on the list to be obtained. Eventually, we would like all the equipment to be in one laboratory for ease of use.

Development Computer System: required for access to the complete system for developing and experimenting with multimedia software. This system is the platform for development of the Knowledge Integration Tools (KIT) described above. The recommendation is a 486 [or Pentium when available] with 16 Meg of main memory, and a 1 Gigabyte hard disk.

Delivery Computer System: required for access for practitioners who wish to develop multimedia presentations and experiment with the KIT tools produced by the research group. This system should be as close to the "typical" system that will be available. Typically, a 386 with 4 Meg of memory and a 80 Meg hard disk. While the development system is very powerful, that power is typically only needed in the creation of the multimedia products. For viewing/using, a system conforming to the Multimedia Personal Computer [MPC] should be the target platform for widespread use.

Notebook Computer: required for portable presentation system that will permit high-profile, proactive, reach out activities by faculty members. It would also allow the use of multimedia applications in the classroom. This system should be as close to the MPC standard as possible. This could also serve as a delivery computer system platform.

Video Camera: required to capture dynamic and still images for inclusion as input to computer-base multimedia presentations.

Laserdisc Player: required to gain access to and retrieve archived footage and data. Also a necessary component as a adjunct to the video compression board.

PC VCR: essential to system and only VCR specifically made to operate with PC. Required for Input, Output, editing, and delivery.

Modem with FAX capability: required to connect to sinks and sources of multimedia applications (acts like and electronic library card to external entities)

Color Printer/Scanner/Photocopier: required as a static Input/Output device (i.e., it is the print equivalent of the VCR) to capture still images, print them, or copy them (Note: the combination of all three functions in one unit reduces the total cost of separate systems).

Postscript Quality Laser Printer: required for large format (i.e., 11x17, 400DPI), high quality output for documentation.

Sound Input/Output Devices: required to support audio Input, Output, editing, recording, and playback.

CD ROM Drive: required Input/Output device to capture digitized stills, dynamic images, and text. Also the standard repository for large amounts of archival material.

LCD Projection Panel: required for mass-projection of multimedia presentations (used in conjunction with notebook computer) in classroom settings, conferences, workshops, and as a recruiting tool for outreach.

These devices taken together provide a prototype environment that is a starting point to permit us (and other units) to experiment with computer-based multimedia and develop cutting-edge tools for computer-based multimedia development. This basic platform will also permit participants (in all disciplines, not just CSIS) to seek external funding for research projects and additional equipment to build larger, more comprehensive facilities.

The software for the laboratory will include: MS-DOS 6.0, Microsoft Windows 3.1, Word for Windows 2.0, Pagemaker 5.0, Aldus Photostyler, Corel Draw 3.0, MacroMind Action! 2.5, Microsoft Video for Windows, and Assymetrix Multimedia Toolbook. In addition, attempts will be made to procure public domain and shareware packages for a proposed Multimedia library of software. This way, the developer would have access to a number of tools, and be able to select the one that best suits their needs.

The proposed prototype laboratory is in keeping with the mission statement of the CSIS Department and directly assists other units to expand their disciplines into new and exciting regions.

FUTURE PHASES

Because we are dealing with cutting-edge technologies and computing paradigms, we do not want to invest in a fully-funded endeavor to build a large comprehensive facility immediately. The prototype lab will permit all players to experiment and learn. Like other sciences and technologies, natural evolution will see some concepts take hold and expand in the long term. Computer-based multimedia directions are no different, and, possibly more difficult to predict. Computer-based multimedia systems require the integration of many disciplines for their effective use and development. Some projects may fail. Some equipment and software approaches may turn out to be cumbersome. What will evolve will be models that capture some fundamental precepts of the discipline.

For the long term we would like to see an open, public laboratory on campus permitting access by students and faculty. Space is available in UCC for such a lab. However, it would be premature to try to construct such a lab this early in the evolution of the science and technology. We anticipate that our experiences with the prototype lab will permit us to seek external funding for the development of a large scale facility.

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DEVELOPING AN INTERACTIVE DATABASE ON A SHOESTRING BUDGET

Patricia Bcker

ABSTRACT

Using power software such as FileMaker Pro 2.0, over 20 years of curriculum materials are being compiled into a database to empower staff to have ready access to decision-making information. This paper discusses the strategies, methods, and design considerations used to develop an interactive database on a shoestring budget.

THE CHALLENGE

The State University of New York's budget has been cut drastically. This has filtered down to the departmental level where lines are left vacant and staff, in some areas, have been retrenched. Simply put, there are fewer and fewer employees to accomplish the same amount of work. The main goals for the university remain the same but with a much stronger emphasis on student recruitment. Due to this stepped-up effort to respond to student needs, it has become extremely important to rely on the technology at hand.

The primary challenge was to develop a database that had to support curriculum information in both credit and noncredit areas and had to be mounted on two different computer systems that are not networked. The secondary challenge was to develop a curriculum database for a staff that was not comfortable using computer technology.

ASSESSMENT

The database had to provide staff with curriculum information with regard to historical course information as well as become the basis for bulletin production and provide the necessary supporting documentation for future curriculum development. During this stage, each would-be user's computer skills were identified along with the cost factor. The development of this project had to be accomplished at minimal cost.

Normally, bulletin production was done using PageMaker on a Mac IIcx computer but the remainder of the staff used IBM computers. The decision was made to develop the database on a Mac computer and then use an exchange program to bring it into the DOS environment. The reason for using the Mac computer as the springboard for development was that a good portion of curriculum information was already compiled on the Mac.

Having made this decision, a search was begun to find software that would support the MAC and IBM environments and would allow users with minimal computer experience to access critical information in a very user-friendly environment.

DEVELOPMENT

In the past whenever staff needed to know curriculum information, it was retrieved through a hard copy file or the department's bulletin was consulted. This was inefficient and time consuming since the staff member seeking the information never knew for sure what was the latest and most accurate information.

Consolidating all of the course information into one central curriculum database available to staff on their own computers was important for information consistency with regard to bulletin publication, scheduling, and student advisement. In order to accommodate the many different levels of computer users, it was only logical to use a database that would support multimedia.

FileMaker Pro 2.0 was chosen as the database program for the following reasons:

1. It is a powerful database program, but easy to use.
2. The low cost of the program.

3. It supports up to 16 pages of text in any text field.
4. The program is available for both computer systems.
5. It lends itself to multimedia presentatior
6. It is compatible with the other software in use.

Using the hard copy file and the bulletin, flowcharts were used to give an overall picture of how the information was to be broken down and accessed. Flowcharts also showed how screens were to be linked via various scripts and buttons.

BUILDING A PROTOTYPE

The idea was to work with the most active curriculum and work backwards so that eventually the database would also serve as an archive.

At first 20 hard copy files were used to determine the types and number of fields needed. Any curriculum information that had been entered in PageMaker was imported into FileMaker Pro so input was kept to a minimum.

The sorting of the information was very important because the information would be used for student advisement, publications, and general departmental information. All of the would-be users basically needed the same information but in a variety of ways. In order to accommodate the different ways information had to be presented, various layouts were designed.

Once the cross-sorting and layouts were designed, more curriculum information was imported into the prototype. The next step was to make sure the database would accommodate publication requirements. After this was achieved, the database had to allow for easy manipulation through the program by the user.

By adding scripts, buttons, and sound, the user is able to navigate through the database easily just by clicking and responding to the on-screen directions. All of the behind-the-scenes workings have been hidden from the user's view. Users with very limited computer experience are able to retrieve information without feeling intimidated by the system.

CONCLUDING REMARKS

In order to accommodate budget cuts and also meet the needs of a decreasing workforce who need quick access to information for student advisement, curriculum development, and bulletin publication, it was necessary to construct a database that would accommodate the many different user levels. Resources were very limited so an off-the-shelf power software package that would support multimedia was chosen.

The initial success of developing this type of data base demonstrates the power of these new software packages which support multimedia. In this case, the ease of accessibility of information allows for a closer working relationship between administrators, program directors, departments, and student advisors.

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DEVELOPMENT AND EVALUATION OF A HYPERTEXT-BASED MULTIMEDIA TUTORIAL FOR USE IN NEW EMPLOYEE ORIENTATION

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ABSTRACT

This paper discusses the effects of hypertext and multimedia on training. Research in training, computer-aided instruction, and hypertext supports the use of a hypertext-based interactive multimedia tutorial in orientation of new employees. An empirical study, comparing a video training tape to a newly developed multimedia program, is briefly discussed. The multimedia program elicited the same level of performance and satisfaction from its users as the video, while giving more personal control over the material. Implications for the fields of training and orientation are discussed. Design guidelines are included to aid further development efforts.

BACKGROUND RESEARCH

Well-designed training programs can have a positive effect for individuals, as well as for organizations. Researchers (e.g., Goldstein, 1993; Klein and Hall, 1988) cite a trend toward more sophisticated technology, and changes in the skilled job market. More sophisticated systems demand highly trained employees. However, demographics promise more unskilled and undereducated youths entering the job market (Goldstein, 1993). This combination of highly skilled jobs and underskilled employees enhances the need for learning to occur within organizations. Using computers may be one way to effectively train new employees. Using computer-aided instruction, users can go through a computer tutorial at their own pace. (The abbreviation "CAI" in this paper will substitute for this term, as well as computer-based, computer-assisted, and computer-managed instruction.)

The emerging field of hypertext has added new dimensions to computer training possibilities. Conklin defines hypertext as a simple windows concept, "Windows on the screen are associated with objects in a database, and links are provided between these objects,..." (1987, p. 17). These links are most often given in the form of graphical "buttons" which allow the nonlinear organization of a document. Navigation through a nonlinear document has been one of the strongest arguments against the use of hypertext. The confusion users may encounter while navigating through its products has been referred to by many as "getting lost in hyperspace" (Conklin, 1987). One potential solution to this issue may come in the form of cognitive mapping theories (Lynch, 1960; Tolman, 1948). Tolman proposed that these maps include recorded routes and paths that form spatial relationships the brain can use to navigate through places. Lynch's (1960) further description of cognitive landmarks may serve as a valid extension to creating hypertext programs. By defining subsets of the overall map, the developer offers more structure, and therefore, may improve learning capabilities.

Along with these potential solutions have come further technological developments. Expanding hypertext by including video, voice, and animation is referred to as hypermedia (e.g., Blattner and Dannenberg, 1992). Hypermedia can be seen as a subset of multimedia. Our definition of multimedia has, in the past decade, evolved to mean the integration of auditory, textual, and visual information (Kozma, 1991). The term hypermedia refers to the presentation of these modalities in one device (e.g., a computer) utilizing hypertext capabilities. This offers the learner more channels to receive the material. The concept that these multiple channels may benefit the learner is not new to learning theorists. A number of theorists have suggested that there are ways, other than verbal, in which information is coded (Paivio, 1969; Rissland, 1985; Underwood, 1969). A multimedia presentation may make a person's memory of information richer. Textual, auditory, and visual information used together may enrich the learning process.

Along these lines, Ambron and Hooper believe that the new developments in media may provide lasting changes in education. They feel that through multimedia and its nontextual nature, "education can focus on human thought and thoughtfulness in a range of media, and defocus from memory of textual facts as the current very new potentials are realized" (1988, p. 322). Instead of memorizing, students can more easily concentrate on learning concepts and broadening ideas.

FORMATION OF RESEARCH IDEA

New employees at Clemson University watch videotapes to learn some of the information they need about available benefits programs. This method allows no choice of subtopic, and often results in employees "tuning out" important information. This study involved the development and evaluation of a hypertext-based multimedia

presentation in order to determine its effectiveness relative to the currently used video information. The benefits program chosen to test was Section 125 of The Tax Reform Act of 1986. The specific section used was "MoneyPlus" because of its length, relevance, and detailed subparts. Its Medical Spending Account, for example, allows employees to set aside pre-tax dollars to be used for medical fees during the year. In many cases, using MoneyPlus can increase an employee's spendable income. Another convincing factor for the choice of content was the relatively low number of employees actually using the program. The Benefits and Personnel Offices at Clemson University expressed a need for more accessible training in order to better inform employees. The multimedia tutorial and videotape were used to explain this opportunity to employees.

DEVELOPMENT OF THE TUTORIAL

The videotape used in the Benefits Office at Clemson was developed by the company that processes all claims in the area. It was approximately 20 minutes in length, and consisted of a woman describing the benefits program. Occasional text and graphics appear on the screen, and the video concludes with an example of one employee's potential savings.

The hypertext program was developed with the use of Supercard, a hypertext-based program which enables the creation of interactive tutorials with the additional video and sound capabilities. All audio information, excluding specific program-related instructions (e.g., "Welcome to the MoneyPlus Interactive Tutorial..."), was taken directly from the video. The computer program was run on a Macintosh IIsi color computer, and required only the use of a mouse. Its length varied with each person. Most employees used the program for approximately 20 minutes.

Development of the tutorial was aided by an outline for CAI design (Criswell, 1989): (a) environmental analysis, (b) content clarification, (c) establishment of goals and instructional objectives, (d) sequencing of topics and tasks, (e) courseware production, (f) designing each frame, (g) programming the computer, and (h) evaluating and revising the program. Additional advice was taken from Criswell, Boyer, and Miller (1990).

The program consisted of 5 segments: An introduction (to both the system and MoneyPlus), the Medical Spending Account, the Dependent Care Spending Account, Important Notes on Both Accounts, and a window with samples of the Enrollment form and Claim form. Employees could choose which of the segments they viewed from a Topics Card. From any screen in the tutorial, employees could return to the Topics Card, go forward or back one screen, or quit the program. Most cards (screens) in the program included voice, text, and color-scanned pictures. Cards introducing new segments included only text and pictures. Lessons learned in the development stage of this project are discussed in the final section of this paper.

PRESENT STUDY

Thirty-six full-time employees at Clemson University, 20 females and 16 males, participated in the study. Both new and current employees were used because of a lack of a significant number of eligible new employees. None of the current employees were enrolled in MoneyPlus at the time of the study. Employees were assigned to either the Hypertext group or the Video group. After their sessions, all employees completed two questionnaires. The first, a System Evaluation (SE) inquired about clarity and consistency of presentation, organization of material, and ease of use. Another dependent measure was based on the second survey, a Comprehension Questionnaire (CQ). The CQ tested employees' understanding of the material. Its questions referred to specific points covered in both the video and computer program.

RESULTS OF THE STUDY

All comparisons between groups were based on Analyses of Covariance. The covariate in these tests was job category, as suggested by the Personnel Office at Clemson. Interest in this particular benefits program varies as a function of job.

System Evaluation (SE). Table I shows a summary of the results of all items which appeared on the SE for both groups. The overall rating was a mean of all items whose desired response was a reflection of positive or negative feelings toward the systems themselves (Item sets 1, 3, and 7 in Table I). Comparisons between groups showed no significant difference in overall rating, $F(1, 32) = 2.44$, although hypertext subjects' ratings were slightly higher than video ratings.

Individual items were compared by group. None of the items showed a significant difference between groups. Mean ratings for each of these items are included in Table I. Subsequent t-tests were performed separately for each, by group, to determine whether or not items were different from the neutral point of 4. The 95% confidence

intervals present the amount of agreement among subjects in a group. A smaller confidence interval demonstrates more consistency within the group.

On the average, employees in both groups believed that the presentation they saw was easy, satisfying, and interesting. Employees were satisfied with the time taken to go through the presentation, and felt it was a good way to present the information. Employees did not believe that they needed more control over either presentation, nor did they feel the information should have been presented in person. In fact, the hypertext group significantly disagreed with this idea. Both groups indicated that they would have liked the ability to enter personal information in the program and receive an estimate of dollars saved. Finally, employees rated the programs as organized, consistent, and clear.

Additional items included on the System Evaluations for the hypertext group asked specifically about the clarity of instructions and frequency of feeling lost in the program. Employees rated the instructions about the hypertext program as clear ($M = 6.53$), and reported very few feelings of uncertainty about location in the program ($M = 6.38$). Means for both items were significantly different from the neutral point, $t\ (16) = 11.92$ and $t\ (15) = 8.74$, respectively.

Comprehension Questionnaire (CQ). Similar to the SE responses, CQ answers were combined for an overall score. An adjusted overall score represented the percent of correct responses within the sections viewed by the employee. This adjustment was made because of the ability of hypertext subjects to skip sections. For example, people who do not pay child care for adult care may not wish to know the details of the Dependent Care Spending Account. This individualization (i.e., skipping of at least one of the available sections) was apparent in 47% of the hypertext subjects. For employees in the Video group, adjusted score was equal to percent of correct responses on the entire questionnaire (because Video subjects saw the entire presentation). A comparison between the Hypertext and Video group for adjusted score showed no significant difference, $F\ (1, 33) = 1.58$. In fact, means were almost identical (Hypertext $M = .74$, and Video $M = .79$). Subscore comparisons also showed no significant difference.

CONCLUSIONS

This study compared a hypertext-based multimedia program with a traditional video. Hypertext employees were significantly satisfied with the presentation. All items on the System Evaluation relating to satisfaction were rated significantly different from the neutral point. This result was also found in the Video group.

Although satisfaction ratings were higher in the Hypertext group, they were not significantly different from Video subjects' responses. However, almost half of the Hypertext subjects took advantage of their ability to skip certain sections of the presentation. Perhaps a difference in satisfaction ratings would be more apparent in a within-subjects design. In the current study, subjects were unaware of the media being compared. Further research may discover that if given a choice of medium, subjects will rate hypermedia presentations higher than traditional videotape, because of the ability to control what is viewed.

The individual SE items give us more information. When asked if this information would be better presented in person, hypertext subjects returned a distinct "No, thank you." The video group's responses, on the other hand, were not different from the neutral point. Hypertext subjects had the ability to choose which information they would review. As they became accustomed to this level of control, these employees may have found the help of a Benefits Officer unnecessary.

Navigation difficulties were measured both subjectively and objectively, neither showing evidence of subjects being lost in the system. Subjective measures found that Hypertext subjects did not report significant confusion. Objective measures did not show a performance decrease in Hypertext subjects.

The study also found that employees were satisfied with the amount of control they had over the presentation that they watched. One would expect that Video subjects would desire more control (e.g., the ability to fast-forward the tape through the Dependent Care Section), and comments made to the experimenter during data collection would support this hypothesis. Many video subjects asked if it was necessary to see the entire tape, or if they were "allowed" to rewind or fast-forward through certain sections. (When given this permission, none of the subjects took advantage of the possibility.) However, responses to the question indicate that overall, video subjects were satisfied with the amount of control they had over the presentation.

Again, it may be that because subjects were unaware of the comparison medium, they believed they had enough control.

As expected, employees were interested in the possibility of entering personal information into the program. Both groups felt that this would have improved the presentation. This type of interaction would not be available in a traditional videotape. A hypertext-based multimedia presentation could readily include this type of information exchange.

The hypothesis that hypertext subjects would achieve higher overall comprehension scores was not supported. Scores for the two groups were almost identical. One possible explanation for this is that employees were tested for comprehension immediately after their presentations. Retention at this short amount of time may leave little room for a difference. Perhaps to determine whether or not hypertext had a longer-lasting learning effect, further research should test subjects at a later time. The existence of multiple codes for hypertext may enhance long-term retention.

A second explanation for this finding may be found in the actual content of the two programs. In order to keep the conditions comparable, it was necessary in this study to use only information in the video to create the multimedia presentation. However, one of multimedia's foremost advantages is its flexibility. The number of different ways information can be presented with multimedia is yet untold. For example, it is important to note that this study (because of financial- and time-related constraints) did not include multimedia's more famous component, motion video. The inclusion of video segments into the hypertext environment may have created its own effect.

IMPLICATIONS

According to this study, employees are just as satisfied with a hypertext environment as with a videotape. Although immediate testing showed no difference in learning, it is also important to note that performance was not decreased by hypertext and multimedia. Employees did not report feeling lost. Objective measures of success showed that hypertext subjects performed as well as video subjects. The benefits of satisfaction with the presentation, and equivalent levels of performance may lead one to the conclusion that hypertext and multimedia are under-utilized presentation media. More research needs to be completed in this area to determine the actual benefits of hypertext and multimedia in a learning/presentation environment. This author suggests that further research in this area should present information to a subject in a within-subjects design, to provide a better basis for comparison. Researchers in this area may also find it useful to test subjects after a longer retention period, as well as immediately after presentation.

DESIGN GUIDELINES FOR THE BEGINNER

A number of lessons were learned, through research or trial and error during the creation of this tutorial. A listing of these may ease further attempts to study multimedia and hypertext.

1. Choosing your development program. Although Supercard was eventually used for this project, it was not the first available program. If you will be learning a new program, it is important to determine the capabilities and limitations of the software package you choose.
2. Beginning development. When learning a new authoring program (e.g. Supercard), do not use your desired project (e.g. the MoneyPlus project in this case) as development practice. For learning purposes, choose a similar, but separate idea to practice with. Although time consuming, finishing a practice-project will alert you to design shortcuts and allow you to circumvent a number of design problems. For example, in Supercard (similar to Hypercard) one background can suffice for each window. Designing your backgrounds first will speed further development. Learning this in the midst of your desired project can be frustrating, and may warrant a new beginning. With a significant amount of time already spent on this project (practicing) you may bypass the idea of starting over in order to save a few good ideas. However, if you learn this important piece of information during an irrelevant practice project, you will be able to develop your next one more efficiently, as well as incorporate those few good ideas. Incidentally, this supports the practice of recording everything you do.
3. Hypertext use. First, if you're planning to use a hypertext environment, be sure that the information is suitable. Linear information is not necessarily easily divided into clear subsections for hypertext. Second, include enough visual landmarks such as "Screen 1 of 7" or a button to check position in the program ("Map" link). Never assume your users will know where they are in the program.
4. Multimedia use. Be aware of the costs of multimedia. Time, price, and computer memory are of utmost importance in this area. Adding video to your project may sound like a terrific idea, but complications can follow. Make sure you have the correct software to edit the clips, run them on your computer, and import the video into whatever authoring program you are using. In the case of Supercard, it is necessary to purchase a video board, and a completely separate program for importing. Video clips, sound, and even still pictures will take an enormous amount of computer memory. Be sure you have allotted enough time to learn new procedures.
5. Interface design. Story boards are essential. Although it may seem more fun to jump right in and begin designing your Interface, it is important to know where you are going, and what needs to be on the screen. Simplicity is the key. Do not crowd the screen with too much information, or too many buttons. Beginning users

will only be confused. Good references to check out on this complicated topic are Laurel (1990), Potosnak (1988), and Wadlow (1990).

6. Usability. Know your user. Usability engineering guidelines (Gould and Lewis, 1985; Nielsen, 1990) urge us to be aware of the user, and design the interface according to user expectations. Before you begin, survey or interview potential users to determine what they would expect in regard to screen appearance, and order of information.

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EDUCATIONAL TECHNOLOGY AT THE UNIVERSITY OF NOTRE DAME: SUPPORTING FACULTY DEVELOPMENT

C. Joseph Williams and Thomas C. Laughner

IMAGINE THIS SCENE

You are a professor of German drama about to teach a class on a recently written German play. You walk into the classroom to find only an overhead projector in the corner of the room where, in fact, it will stay unused. As the students assemble, you pick up a hand-held remote control unit and press a power button on a wall control panel. After a few introductory comments, you lower the lights and press the Scheduled Program Select button and then the Play button on the remote control-a videotape of the play begins, projected through a ceiling-mounted projection system. In the middle of the first act, you press the Stop button.

The play takes place in a castle on the Rhine. You press the Scheduled Program Select button and then the Search button; you enter five numbers and immediately images a castle on the Rhine from a videodisc appear on the screen. You show several views of the castle and the surrounding areas, and then press the Scheduled Program Select button again to play some music from the period of the play from a CD-audio disc. You also have some personal slides you have taken of costumes of the period which you found at a museum on your travels to Germany last year-another press of a button and the slides appear. After some discussion of these various elements, you press buttons on the remote control to begin showing the videotape of the play where it left off.

At the end of the first act, you press the Stop button, return to the wall control unit and press another button to switch to a computer display, then move to the computer podium on the other side of the room. Clicking the computer's mouse, you show several still images from the videotape and play particular sections of the dialog which you've digitized. The text of the dialog is shown along with the image and sound. With each click of the mouse new images with text and sound appear along with major points you want the students to remember about this section of the play and questions for the students to discuss. The discussion continues until fifteen minutes before the class ends. You've previously arranged at that time to contact a colleague at another university who knew the playwright personally. Returning to the wall control unit you pick up the phone and make the call. Switching the audio to the room's speakers, your colleague makes several comments about the playwright and answers questions from the class. No one wants to leave when the class ends.

DeBARTOLO HALL AT NOTRE DAME

A version of the above scenario is often used to explain the media-delivery and computer capabilities of a new classroom building, DeBartolo Hall on the campus of the University of Notre Dame, by Sr. Elaine DesRosiers O.P., Director of Educational Media and administrator of the building. This new classroom building has eighty-four classrooms equipped with Media-On-Call, an optical-fiber-based, computer-controlled, audio/video delivery system which provides access to up to six different media devices during one lecture period (videotape, videodisc, audio CDs, audio cassette, 35mm slides, 16mm films, electronic still images, etc.). Media-On-Call was developed and installed by Dynacom, Inc., of Mishawaka, Indiana. A similar system has been installed at Ball State University (see Fissel, 1990 pp. 59-61) and approximately 100 other schools and colleges.

All classrooms in DeBartolo Hall with fifty seats or more have a ceiling-mounted, large-screen, color projector for use with the Media-On-Call system or computers. Smaller classrooms have large stereo video monitors. All classrooms are equipped with an overhead projector for transparencies and larger classrooms have separate screens for overhead and video projection. The six 100-seat classrooms, three 250-seat classrooms, and the 450-seat auditorium have separate sound systems for instructor speech reinforcement and media playback. Four of the rooms are equipped for audio/video teleconference origination. A Media Resource Center houses over 800 videotape and videodisc titles for use in classes, individual carrels or small-group viewing rooms.

USING COMPUTERS IN DeBARTOLO HALL

Computerized podia for instructors are provided in nine classrooms in the building providing access to Macintosh, DOS/Windows, SUN, or NeXT computers. Some podia are equipped with videodisc and CD-ROM players for using computer-controlled multimedia presentations. LCD projection plates and portable computers can be scheduled for use in smaller classrooms for use with overhead projectors.

Two collaborative classrooms provide 30 Macintosh IIci computers and 30 IBM PS/2 Model 90 486 computers for classes needing hands-on computer use. Both classrooms have two ceiling-mounted video projectors for use with the instructor's podium computer or Media-On-Call. A seventy-eight station computer cluster, available twenty-four hours a day, has five Macintosh and five IBM computers designated for multimedia use with videodisc players and CD-ROM drives. All computers in DeBartolo Hall, including the classroom podium computers, are connected to campus and worldwide networks.

The Office of University Computing (OUC) provides support for computers in DeBartolo Hall and support for faculty development of computer-based classroom presentations and learning resources. Educational Technology Consulting of the OUC provides information on the design, development and use of educational technologies, provides classes on presentation and authoring software, and manages a faculty development lab which provides access to production equipment including scanners, digitizers, and other specialized equipment. Educational Technology Consulting assists faculty with information design, screen layout, navigation issues, and technical considerations for projects.

FACULTY USE OF COMPUTERS

Since its opening in the Fall of 1992, many faculty have already begun to use the computer and media facilities provided by DeBartolo Hall in a variety of ways. In addition to using computer applications for simulation and visualization in courses for economics, mathematics, and engineering, other departments using computers include:

Freshman Writing Program-professors use the Daedalus program to guide students through writing exercises using prompts displayed by the program. Students write commentaries and criticisms of each other's work through the computers and then revise their writing using Daedalus or other word processing programs. Professors also use computer presentations and the Media-On-Call system to present media relevant to writing projects.

Design-a professor uses a NeXT computer in a class on book design in which students are able to make suggestions for changes or design alternatives and see them implemented immediately on the projection screen.

Statistics--using a computer-based presentation, a professor can show complex formulas in class using mathematcial fonts and color. Students can immediately review the class presentation after class or at any time in the computer clusters.

Art History-a hypermedia tutorial, based on the ideas of the Renaissance humanist Leon Battista Alberti, is being developed by a professor to introduce students to the interrelationship between art, politics, religion, philosophy, and literature in fifteenth-century Italy.

Language arts-a professor is using existing software to speed up the process of learning kanji and kana pronunciation, stroke order, meaning, and reading skills through dialogues and grammatical drills.

Naval Science-computer-based presentations have been created for lectures on ship and weapon mechanics including animated diagrams and digital video.

English and American Literature-a HyperCard-based project will allow advanced students to interpret and analyze poems, and specify information about the poem, stanzas, lines, and words.

English-a learning resource has been developed of materials normally kept on reserve in the library relating to Malcolm X, his pronouncments on race relations, Black Muslims, and other people and events related to his life. This resource contains digital video, audio, images, and text information to be used as a preview for students reading the Autobiography of Malcolm X. Another professor has created a similar presentation on women writers, artists, and musicians during World War I which includes text, images, video, and music as a context for her students' research and writing on this subject.

Chemistry and Biochemistry-digital video is being developed to show laboratory setups and experiments. Visualizations of molecules, generated by a Silicon Graphics computer, are being produced as digital movies for use on more-widely available computers. Students in some sections of chemistry are required to use computer-based presentations for their class projects.

Theology-images and maps used in two Foundations of Theology courses, required of all Notre Dame students, have been digitized and made available to all faculty teaching these courses. A special HyperCard tool (described below) has been developed to help select, order, and display the images as well as display text frames and digital video and sound segments.

USING NEW TOOLS AND NEW CAPABILITIES

The projects mentioned above take different approaches to the use of computers in the classroom. Some of these projects have begun to explore capabilities of computers to work with media to do things the Media-on-Call system cannot easily be used to do, including:

Projecting multiple images-it is not possible to project two slides at the same time-a regular need of courses such as Art History-through the Media-on-Call system without producing a new slide with both images. Computers can be used to display two or more images at the same time. Non-sequential image access and image manipulation-slides can only be used sequentially through Media-on-Call while digital images can be accessed in any order. Faculty are also beginning to manipulate digital images to show enlargements of details in image, for example, which were not previously available.

Multiple projector effects-one faculty project, which normally uses pin-registered slides with two slide projectors and a dissolve unit to fade one slide into the next, has been converted into QuickTime movies using a cross-dissolve to achieve the same effect. Students in the Art Department are creating multi-image/sound projects which would normally require many slide projectors and sound-control devices to run the projectors.

Digital video and digital sound-with Media-on-Call, videotapes and audiotapes must be cued to the starting position to be used conveniently. Professors are beginning to digitize specific video and audio segments and present them through the computer which allows faster and more precise control.

In addition to using commercial computer presentation applications (e.g. Persuasion, PowerPoint, etc.), the Educational Technology Consulting group in the Office of University Computing has developed a tool in Apple's HyperCard (currently being converted to Asymetrix's ToolBook) which helps faculty organize and present text, images, sound, and digitial video. Basically, the tool consists of a palette containing buttons which help the user to create text frames, import images or movies/sound files and to organize these elements into a presentation without knowing the details of HyperCard or Toolbook. The advantage of using this tool is that faculty can develop their content using products that can easily be extended to include the structural and navigational elements needed to create learning resources which can be used by students independently in the computer clusters. This tool also allows faculty to concentrate on their content rather than on learning to use more complex presentation or authoring applications. This approach reflects a perspective of faculty development as an evolutionary process in which usable products are always available, and constantly being enhanced (Hypermedia) instead of a project managed process in which nothing is available for use until all elements are in place and thoroughly tested (Fixed Media).

AN ENVIRONMENT FOR APPLIED INTERACTIVE MULTIMEDIA

A survey taken during the Spring semester 1993 of faculty attitudes toward their use of computers and media suggests an increased interest in using educational technologies-away from using transparencies toward computer-projection, for example. Future surveys may confirm an increasing trend toward using interactive multimedia and computers in the classroom and toward developing interactive multimedia learning resources for students to use independently. DeBartolo Hall provides a readily available environment for faculty to experiment with computer and media enhancements to teaching and learning at the University of Notre Dame. As the capabilities of computers, media, and communications continue to expand and these industries begin to converge, it will become increasingly important for faculty to have the skills necessary to create computer and multimedia-based materials for their students.

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FROM HYPERTEXT TO HYPERMEDIA

Wilma Strang, Hassan Khan, Vicki Simpson, Dave Slater and Sheila Hill

INTRODUCTION

Higher education in the UK is in the grip of change. Universities are being asked to admit more and more students from wider and wider ranges of backgrounds than ever before. In 1991, a 50% increase in student numbers was being predicted by the year 2000. (1) This now seems to have been something of an overestimation but numbers are certainly on the increase. As a direct result, traditional teaching strategies in universities are being called into question. Standards of both teaching and research are being scrutinised and it has been concluded that - "The greatest challenge is to persuade a majority of those involved in higher education to see teaching as their prime activity and as one posing intellectual challenges and offering rewards comparable to those of standard research"(2).

The use of the word 'persuade' would seem to imply the probable difficulty of effecting this attitude change in lecturers. To date, only research in the form of publications has been seen as the route to recognition, promotion and advancement. Time spent on the preparation of teaching materials, on curriculum development of any sort has often gone unsung, largely unnoticed and usually unrewarded.

Thus, the same report quoted above concludes - "The development, and imaginative use, of shared educational resources, and the necessary research into learning processes and new forms of large-scale teaching, will all require new organisational structures, and the creation of supporting infrastructures at national and institutional level."(3)

It would be wrong to imagine that university lecturers have never been interested in developing and implementing new teaching methods. Nevertheless, for the first time ever in higher education in the UK, lecturers are being forced to reconsider their teaching methods. They have little or no choice. Increased student numbers,shorter degrees, modularisation, semesterisation and distance learning, not to mention severe pressure on the usual resources like library books and reprographic facilities are all issues currently bearing down on teaching academics. Effective and well-structured staff development and support are vital to see staff over this period. As funds tighten, academics move around less. Staff in post in HE institutions today are likely still to be in place in the same institutions in 10 years' time. If new forms of teaching and learning are to be made available to a larger and more diverse student clientele it will be, for the most part, staff in post today who will have to deliver them.

TECHNOLOGY INITIATIVES

Current initiatives in the UK seek to promote technology as a way of both improving the quality of learning for students in higher education and solving some of the problems facing their teachers. The Information Technology and Training Initiative was set up in 1991 by the Information Systems Committee of the Universities Funding Council to develop software and training materials so that universities "...can derive optimum advantage from the widespread application of multimedia and hypertext technologies to the education process". (4)

In August 1992 the Universities Funding Council announced 43 projects which were to be funded under the Teaching and Learning Technology Programme. The aim of this programme is "...to make teaching and learning more productive and efficient by harnessing modern technology. This will help institutions to respond effectively to the recent growth in student numbers, and to promote and maintain the quality of the provision." (5)

Introducing new technology into teaching and learning in UK universities requires carefully planned change management. As a result of expansion in the 1960s, the bulk of academic staff in universities are bunched in the 35 - 50 age group. Not only are they likely still to be in post in 10 years' time but many of them have already been in post for at least 10 years. This is a group of people whose experience of technology is likely to be peripheral. At best, they will have had experience of using word processing but many will not even have had that. Clearly, despite the claims being made in current initiatives for the role of technology as a tool for increasing productivity, the technology is not something which staff can be expected to take on without guidance and support before, during and after training. It is salutary to compare the current situation in universities with that in schools where - "Providing teachers with the necessary skills, knowledge and confidence to use IT effectively in their teaching remains the greatest single task for schools, local authorities and government. Those teachers who are giving a lead in schools have almost all acquired their expertise by self study and in-service training ... the considerable progress which has

been made owes much to the willingness of teachers to attend courses, take computers home over weekends and holidays and spend countless hours on their own or with colleagues working out how to use particular software".(6)

It is therefore no surprise that one quarter of the TLTPprojects address problems of implementation within single institutions, with staff development a major component.

In the case of both initiatives, the emphasis is on the curriculum driven nature of the work the funding supports. The projects cannot be seen as technology driven. They must show themselves to be responses to curriculum change, which is both a desirable and inevitable feature of any educational establishment's response to cultural change in the world at large and in the institution itself. Indeed the curriculum which does not respond to a rapidly changing culture loses credibility.

While the scale of the changes required is such that an evolutionary form of development is both inevitable and desirable, there is seen to be an urgent need to foster and introduce innovative approaches and structures. The Hypertext Campus Project at the University of Kent at Canterbury has been funded under the TLTP initiative to do both.

THE HYPERTEXT CAMPUS PROJECT

The Hypertext Campus Project began at the University of Kent in October 1992 and is planned to run for three years. The major aim of the project is to establish a centre of good practice in hypertext use in Higher Education in the UK by -

1 establishing a Hypertext Support Unit. The Unit comprises four full time equivalent members of staff. Although most of the staff are sited in the Computing Laboratory, strenuous efforts have been made to characterise the Unit as a campus-wide resource for all academic staff at all levels. Staff who are apprehensive about and unfamiliar with new technology find direct access to the Computing Laboratory rather forbidding. A public office, away from the Computing Laboratory, has been established. This is the office into which lecturers are encouraged to call at any time.

   The staff recruited to work in the Hypertext Support Unit have been selected for their communication skills, their ability to work with and alongside non-computing academic staff and their previous experience. All have degrees in subjects other than computing as well as degrees in computing itself and they have experience in teaching, in staff development and in the production of hypertext learning materials. This is a major feature of the Project strategy. Although a recent national survey in a representative sample of UK universities (7) found that - "...a cultural change has occurred among academics in recent years, and a high proportion are now enthusiastic about meeting the challenges offered by computer based learning" there is still nevertheless, according to the same report, perceived to be "...a lack of career incentives for both adoption and development of courseware". HSU members involved in promotion of hypertext as a tool for the development of learning materials need to be highly sensitive to staff attitudes to such work.

2 promoting the pervasive use of hypertext through staff support and development. The Project is firmly embedded in the University structure and the Hypertext Support Unit has high level support for all its staff development activities. Co-operative working with academic members of staff ranges from development which is wholly the work of the HSU on behalf of a member of staff to projects suggested by individual members of staff for which they receive financial support from staff development funds and technical support as and when it is needed from HSU.

3 supporting and offering assistance in all major hypertext systems on all major platforms. Although the University of Kent is the home of Guide, which was created there by Professor Peter Brown, hypertext learning materials are not created in Guide alone.

4 delivering documents for staff and students giving guidelines for adoption of hypertext, choice of system and good authorship practices. This will be a major feature of our work.

5 providing workshops for staff to spread initiatives, integrated with UKC's staff development workshop programme. We have run informal workshop sessions, formal training courses and short, illuminating technical briefings across the campus. The aim of this pro-active strategy is to reach as many members of staff as possible.

WHY HYPERTEXT?

It would be inappropriate in this company to rehearse the arguments for the adoption of hypertext as a learning environment. The work of Landow (8) and his enthusiasm for hypertext will be well known to this audience as will the invaluable material from the NATO Advanced Research Workshop on Designing Hypertext/Hypermedia for Learning held in July 1989. (9) Just as important are those reservations expressed perhaps most recently by

Hammond - "...basic hypertext systems may fail to provide learners with the support, direction and engagement that learning requires". (10).

Of interest to this conference is the fact that specific reference to multimedia is made only obliquely in the detailed specification of the aims and objectives of the Hypertext Campus Project. The promise made is that hypertext will easily allow extension into multimedia work. Far from being the starting point, multimedia in the Hypertext Campus Project is planned as a feature of the second phase in the developmental strategy we are implementing.

WHY NOT MULTIMEDIA?

The possibility of combining still and moving images, audio, sound, text and interactivity under the umbrella of multimedia has resulted in the re-evaluation of the ways in which information is presented and has opened up new ways of communicating such information. This has obvious implications for the ways in which a teacher/lecturer can communicate with the learner and indeed the ways in which a learner can gather and assimilate information. It is claimed that multimedia learning material allows greater recall of content than traditional methods (11) and although the implications of this improvement are yet to be proved, there is no doubt of the new and exciting potential multimedia has in the teaching and learning process. With the availability of affordable multimedia PC's, CD-ROM technology and increasingly improving networking capabilities, multimedia is both an ideal and practical technology for HE where it can be used in teaching and learning and via research, in the improvement of the technology itself. Multimedia is widely seen as the technology that can meet the challenges facing HE, of the need for extending the student base and providing more intensive teaching programs. The enthusiasm greeting the use of multimedia in education is everywhere - "The need to improve the quality of education both in the home and school environment will be one of the most universal priorities in society during the next decade...a truly multimedia system can offer the type of breakthrough required..." (12)

Why then are we not a Multimedia Campus Project and a Multimedia Support Unit? Why don't we simply introduce the possibilities of, and the facilities for, multimedia learning materials to the academic staff on our campus? As in any teaching exercise, we must begin in the same place as our learners.

1 Money. The availability of equipment is a problem. Hypertext is deliverable now, on existing systems and is reasonably cost-effective to develop. Hypermedia - the distinction between hypermedia and multimedia is taken from Deegan, Timbrell and Warren (13) - cannot be said to be so, at least within our campus and on the scale on which we are charged to work.

2 Text. Our academic staff are preoccupied with text. Thus the Hypertext Campus Project takes text as the appropriate starting point for the eventual development of hypermedia applications, for textual material is the predominant form of learning material in higher education. It therefore represents a logical, structured and familiar beginning in the developmental cycle. We can show lecturers ways of converting their existing paper based materials into hypertext. The main authoring systems of today allow authors to produce hypertext documents with options to introduce and integrate multimedia components such as sound, animation, still and motion video. Once a novice author has constructed a hypertext document a certain amount of experience has been gained of the features, facilities and potential of the authoring system. As a result of going through this learning process themselves, the authors should be better equipped not only to see where multimedia may be incorporated into the structure of their documents but also how to do it.

   Despite the findings of the survey mentioned above, academic staff are still sceptical of the role of technology in the teaching and learning process. To throw them immediately into the technological jungle world of multimedia will only serve to increase scepticism and lose their confidence in the obvious potential of hypermedia. Although it may be tempting to consider buying in multimedia packages for staff to use in their teaching - and certainly this must be a long term aim - the techniques of actually using multimedia applications as part of the provision of learning materials, of how such materials can best be incorporated into a teaching plan are not well understood. Our approach is the opposite to that taken by Ambron, who suggests that those composing multimedia might be best advised to - "Start with Images or Sounds and Then Add Text". (14) By concentrating on involving staff - on however small a scale - in the production of hypertext and hypermedia applications derived from their own text-based materials, we hope to increase lecturers' confidence in and motivation to use this technology in their courses.

3 Experience. The availability of expertise is a problem. There are few good models. In the eighties, Peter Brown, talking about hypertext, said - "...we just have the tools, but no professional designers. Current hypertext documents are nearly all the works of enthusiastic amateurs. Many of them are truly ghastly." (15)

   A similar situation exists today with multimedia and hypermedia applications in that there is a plethora of systems and tools available but the quality of authorship still leaves plenty of room for improvement. Taking

a structured approach should not only improve this scenario but by implication filter through as benefits of using CAL in teaching and learning. The important need for hypermedia is not for further technical wizardry, but for authors who can exploit the medium successfully. It seems, therefore that a curriculum led approach must be the way forward in HE.

4 Standards. Hardware and software standards relating to multimedia (eg MPEG, JPEG, SGML, MHEG MPC etc.) are becoming an increasingly important issue. For CAL applications to be of any real value, due attention must be paid to ensuring the portability, maintainability, longevity and extensibility of the products. Only by investing in and adhering to certain standards can such requirements be met. At present there is a lack of awareness about multimedia standards and the implications of their use. However this situation is being tackled with recognition by the standards community for the need of more information regarding standards, being made available to a non-technical audience. In the UK HE community, a recent plea has been made for "A state of the art report on Multimedia issues". (16)

Another issue that can be raised with regard to the standards question is the longevity of the standards themselves. In such a rapidly changing technological climate the future use of some standards already in place is somewhat doubtful particularly if multimedia follows its natural progression into virtual reality. That, however, is another issue in itself.

THE WAY FORWARD

With text and hypertext as its major focus, the HSU plans to provide a route for teachers to move into the use and development of multimedia applications as follows -

PHASE ONE

1 Based on NEED and/or INTEREST, lecturer receives HSU advice on getting started with hypertext. Lecturer will have some item of text - however small - which will be suitable for conversion into hypertext.
2 With HSU support and training, lecturer MAKES ACQUAINTANCE WITH hypertext tools and techniques.
3 Lecturer COLLABORATES WITH the HSU member to develop a suitable hypertext presentation for the text in question.
4 HSU member DESIGNS AND DEVELOPS the hypertext with lecturer involved at all stages in a cycle of iterative testing and design processes.
5 Lecturer IMPLEMENTS THE APPLICATION, using it as part of teaching/learning process.
6 Lecturer DESIGNS REVISIONS to the hypertext in the light of student reaction and learning experiences of both students and lecturer in its use.
7 Lecturer, with HSU support, IMPLEMENTS THE REVISIONS to the hypertext.

At the end of this First Phase, the lecturer should have -

1 gained confidence in and familiarity with the tools for producing hypertext
2 moved through the cycle from being a learner to being a developer
3 found a sense of motivation drawn from student response and from the possibilities opening up as the cycle is completed.

In effect, a paradigm shift takes place. Because HSU performs the triple role of developer, teacher and supporter, there is no stage at which the lecturer is abandoned. Similar projects where work on CBL materials has been done for lecturers by others on their behalf and then simply handed over have encountered difficulty in any follow up stage. Here, follow up with HSU is positively encouraged so that the lecturer can enter the second phase. In the second phase, the stages will be as in phase one, but with the emphasis on widening the hypertext to incorporate multimedia elements. Thus the stages will be as follows -

1 Based on a NEED and/or INTEREST, lecturer receives HSU advice on bringing multimedia elements into an already existing or projected hypertext. And so on through the stages as in Phase One. In both phases, the NEED and INTEREST factors come from the lecturers themselves. Clearly, NEED may arise as a result of some of the pressures referred to earlier in this paper. INTEREST may come from a variety of sources, not least from the work done by HSU in publicising hypertext across the campus and in demonstrating good examples of hypertext.

To bring about the widespread effective use of multimedia the HSU is adopting strategies which we hope will achieve some of the goals outlined above and avoid some of the pitfalls. In taking this curriculum led approach we hope to help staff make the move into multimedia. The HSU tries to increase their interest in active learning by starting with text and producing hypertext applications which work and have a practical role. It is intended that these

applications provide the basis for the addition of multimedia components where appropriate. The Unit represents both a practical support centre as well as a source of information relating to multimedia. The development of a hypermedia document from text sees the role of the unit alternate between that of educator and developer. By emphasising this role it is hoped that a good hypermedia product is produced but more importantly that staff become competent authors of hypertext and hypermedia learning materials in their own right.

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HOW MUCH IS ENOUGH?: CHOOSING A COMPUTER-BASED VIDEO TECHNOLOGY

Michael Pearce

ABSTRACT

This report describes several technologies for capturing and displaying video on desktop computers. These technologies are analyzed from the perspective of the software designer who is considering including computer-based video in a computer-based training and/or job aiding system. The issues of cost, fidelity, and programmability are discussed for each technology. A table of important factors is included at the end of the report.

INTRODUCTION

Prior to ten years ago, computers were used solely for the collection, processing, and display of text and numerical data. Within the last ten years, computers that can manipulate still picture and sound data have been widely available. In the last five years, motion video has become common on specially-configured computers. The technology of computer-based video includes a number of approaches for displaying motion pictures. Each of these systems has strengths and weaknesses that make it suitable for specific applications. There are many factors that should be considered when choosing a video standard for computer-based training (CBT) and job aiding. These factors include cost of the system, required video fidelity, portability to other platforms, information requirements for the target domain, skills being trained for, standardization issues, potential payback in job performance improvement, and ease of use.

This report provides the reader with the information necessary to decide which computer-based video technology is correct for a specific application. In describing the issues related to computer-based video, this report deals only with the issues of cost, fidelity, and programmability. This report does not deal with instructional design, training issues, organizational issues, or psychological factors; nor does it describe the technologies in great detail. Also, this report focuses on video standards that have been implemented on the IBM PC architecture, as this is by far the most prevalent computer architecture for training. Some of the standards have been implemented on several architectures, although the cost of producing "open-architecture" software will significantly increase the end price of the project, because of the lack of cross-architecture standards and tools.

TECHNOLOGY OVERVIEW

At the most abstract level, the goal of computer-based video technology is to produce motion pictures and sound on the personal computer. There are two steps in this process: capture of the video and playback of stored video. Figures 1 and 2 are schematics of the process of capturing and displaying it on a computer. During capture, the video is transferred from a source (either a video camera or a video tape) to some type of storage media. The capture process requires some type of special hardware to translate the incoming video signal into a format that can be saved on the storage media.

To play back this video, the data is transferred from the storage media to the computer and displayed on the monitor. During this process the data is translated to a format that is compatible with the computer monitor; the translation is done by special video hardware or by the computer's processor. Then the video data is combined with the computer-generated text and graphics and displayed on the monitor.

Since the focus of this report is training, education, and job aiding, the discussion is biased toward video technologies that favor frequent playback. These *asymmetric* methods require infrequent capture of video and frequent use (Le Gall, 1991). Asymmetric methods require more effort to produce the video material, but this effort is paid back in the effort and resources saved in repeated playback. The other class of methods is *symmetric* methods, which are suited for applications that require equal amounts of playback and recording. Examples of such applications are video mail, video telephones, and video conferencing, in which the data needs to be transferred quickly and is not stored for a long time or reused frequently. Because of the low quality associated with symmetric methods, they are usually not well suited for training or job aiding.

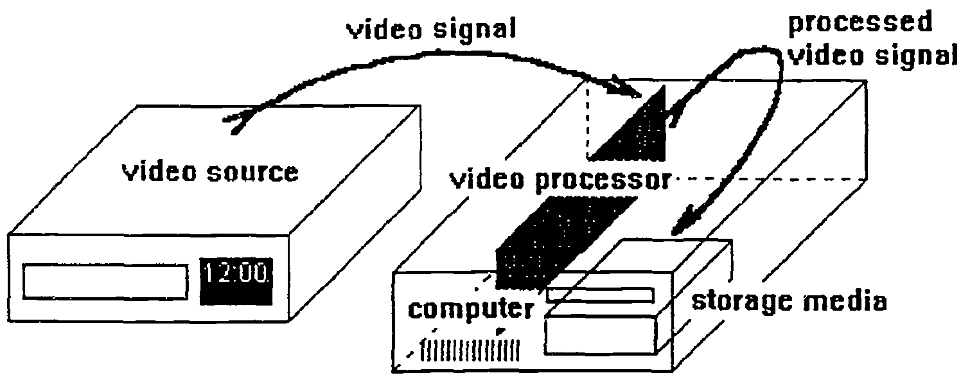

Figure 1. Schematic of capture of video on a computer.

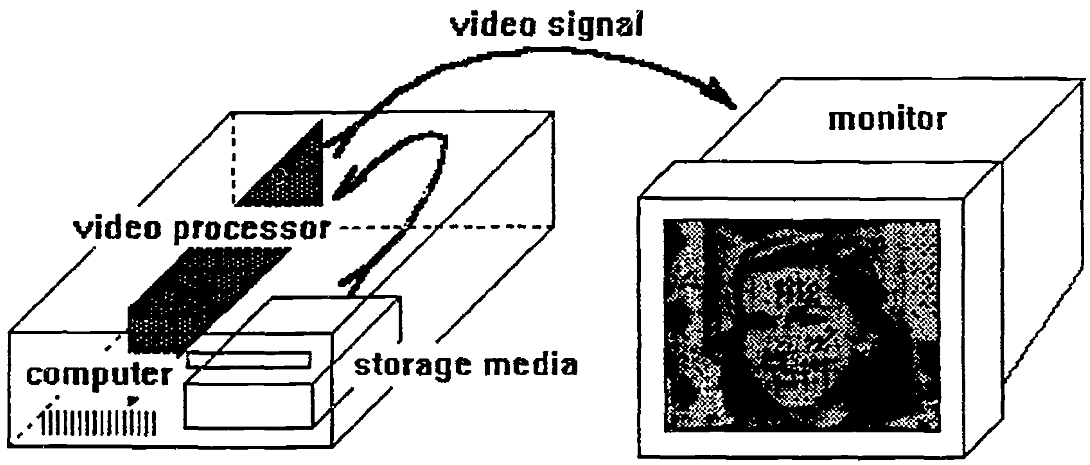

Figure 2. Schematic of display of video on a computer.

The fundamental barrier to displaying full motion video on a PC is the huge amount of data involved. For example, to store one second of full color NTSC video requires about 33 Mb of storage. This is more than 200 times more data than most CD-ROM drives can send to the computer, and is also more data than most computers can process. Computer video systems get around this barrier by reducing one or more of the frame size, frame rate, or colors of the video. This does not always result in an obvious reduction of video quality, because there is much redundancy in video data. Most of the data can be "thrown away" without a significant decrease in picture quality, but more processing is required of the computer to recreate a facsimile of the original image. Since high quality video is not required for all applications, and because reducing video quality reduces the amount of data required for a given segment, most video compression algorithms reduce the video quality (for example, number of colors, contrast, detail, etc.).

EVALUATION CRITERIA

Before discussing the technology of computer-based video, we will describe the three evaluation factors in this report; cost, fidelity, and programmability. The overall evaluation criterion in picking a computer video standard is to get the "most bang for the buck." This means that the video system must provide adequate quality and functionality of video for the minimum cost. If sub-optimal quality video is used, then some content is lost. Poor quality becomes distracting and the user pays more attention to the flaws of the system. For example, quality requirements for a "talking head" type of video is low, since the user will pay more attention to the sound track than

to the video track. But if the domain includes a visual inspection task, higher quality video is needed, because the user must discern fine detail in the video of the objects being inspected.

Cost

A survey of CBT developers found that the most significant obstacle impeding the implementation of multimedia training was the cost of development and the cost of the delivery platform (Kemske, 1992). The production of the video material (writing the script, hiring actors, taping the segments, editing, etc.) is often a large part of the overall cost of creating desktop video; average cost for hiring a team to produce one hour of high-quality video is between $60,000 and $100,000. Production costs can be even higher when including the time of the subject-matter experts, lost productivity, and facility usage during taping. For the purposes of this report, we will assume that you have already shot and edited your video source to a single video tape. The production of the video is largely independent of the technology being used for computer-based playback.

Cost of computer-based video can be broken down into subcategories. These categories are the steps in the process of going from source video to the finished system. We will use the example of manufacturing a consumer videotape to illustrate each of the steps.

Mastering Cost: This is the cost of taking the video tape media and putting the data in a format that is ready to be duplicated. For some video formats mastering will require special processing of the video material, while in others it is only required that the video data be copied to a specific media. Using the videotape example, this would be the cost of producing a master tape that is compatible with the duplication equipment.

Duplication Cost: This is the cost of reproducing the media so that it can be distributed to multiple sites. Duplication costs will vary with the type of media, the number of copies to be produced, and the desired turn around time for the finished product (see Section 5 for more information on distribution media). For videotape production, this would be the cost of duplicating the videotapes, packaging them, and shipping them to the buyers.

Playback Hardware/Software Cost: This is the cost of the computer programs and equipment required to play back video from the distribution media. This type of cost is a function of both the video format and the distribution media. Because the technology for the presentation of video is changing rapidly, this is the most unpredictable part of the cost factors. The highest hardware cost of the technologies described in this paper is $2800 per computer, while the lowest cost is $600, although these prices are dropping at the same rate as those of other computer-related technologies. Using the videotape example, this would be the cost of the videotape recorder and the television set.

The total cost will depend largely on the number of computer systems that are required. While the mastering cost is independent of the number of units being produced, the duplication and playback hardware costs are tied directly to the number of units. For example, a CD-ROM can cost over $300 for a single copy, but costs only $1.40 each for orders of over 500 copies. Similarly, if the video is to be distributed to 600 computers, then you will need 600 copies of the hardware and software for video playback.

Fidelity

The fidelity of the video is a measure of how similar the final image is to the original scene. In all video recording technologies, including film, video tape, or digital methods, there is a reduction in the amount of data captured. This is done to reduce the cost of the equipment for recording and playback. For example, IMAX (a wide screen film standard) has greater fidelity than theater film, which has greater fidelity than video tape, and so on. The deciding factor in choosing a computer-based video technology will be the amount of video fidelity needed for the viewer to understand the content of the video. Too much video fidelity, and the system is more expensive than it needs to be, but too little fidelity and the viewer will be distracted from the content by the poor quality of the video.

Video fidelity differs along five dimensions:

Frame Rate: This parameter is measured in the number of frames displayed per second. The point at which the human eye begins to see motion is about 20 frames per second (fps). At a frame rate that is significantly slower than this, the viewer begins to see a series of frames instead of continuous motion. Since cutting the frame rate in half will also cut the data rate in half, this is a common way of reducing the amount of data in a video segment. While the author could find no research on the effect of frame rate on video image understanding, studies in the domain of Unmanned Aerial Vehicles have found that frame rate has a greater impact on performance than does resolution of the image (Swartz, Wallace, and Tkacz, 1992).

Number of Colors: Although the human eye is very sensitive to changes in color and brightness, the mind can understand pictures that contain only a few colors. This is because color information is often redundant; for example a simple "cartoonish" drawing with a couple of primary colors is often adequate for the viewer to recognize a picture. Color depends on physical factors (wavelength, purity, and intensity), on psychological factors (saturation, brightness, contrast), and on contextual factors (image size, position, motion, and adjacent colors) (Thorell and Smith, 1990). It is therefore difficult to provide quantitative guidelines for the use of color. In any case, the viewer

should be able to recognize what is being presented, but should not be overwhelmed by the number or contrast of the colors.

Picture Size: This is measured in the number of vertical and horizontal lines that make up the picture. For example, a standard NTSC television picture has 672 vertical lines and 525 horizontal lines of pixels. A PC with a VGA display adapter has slightly less resolution, with 640 vertical lines and 480 horizontal lines. Because of the large amount of data required for full-screen video, most digital video methods display video on only part of the screen, thus discarding some of the data in the original signal. For software-only playback, a 120 x 180 pixel video window size (1/16 of the standard PC display area) is standard, and is adequate for "talking head" applications. But for tasks that require higher fidelity pictures, this resolution does not present adequate information to the viewer.

Audio Fidelity: The amount of data required to record an audio signal is small compared to the amount of data for video, and so its quality is usually not reduced significantly by computer-based video techniques. The data rate can be reduced by decreasing the rate at which the original audio signal is sampled. But doing this also decreases the frequency response of the recorded signal, much in the same way as reducing the frame rate of a video reduces its realism. For example, telephone-quality monophonic audio has a data bandwidth requirement of approximately 8 kb per second. Compare this with the 176 kb per second data rate of audio CD-ROM players. Also, the dynamic range, which effects the audibility range of quiet and loud sounds, can be reduced to decrease bandwidth requirements, although this is not much of an issue for video that has only voice sound.

Synchronization of Audio and Video: A video signal is synchronized if the audio and visual events correspond. If the synchronization of the audio and video tracks is off by more than half a second, then this mismatch becomes noticeable. It becomes particularly distracting when a person is talking, or when there are obvious visual cues such as clapping or other distinct sounds. Synchronization is partially dependent on frame rate; at frame rates below 15 fps the video will start to look unsynchronized because of the "missing" frames. But even full motion video will look poor if the sound track does not follow the actions in the video (as seen in many over-dubbed foreign language movies). The effect of poor synchronization is that the viewer becomes distracted from the content of the video, possibly missing important points that the video segment is trying to make.

Programmability

The issue of programmability of computer-based video concerns the ease with which video can be incorporated into a computer program. A particular video technology may be inexpensive and have high fidelity, but if it is difficult to work with, the chances of it being used are small. Common reasons for this are that the technology does not provide the functionality required for the target application, or the labor cost of working with the video is too high. The ease of programmability is closely tied to the type of platform that the software will work with. For the purposes of this report we will assume that the target platform is an IBM-PC compatible computer with an Intel 80386 processor with a 20 MHz clock speed.

Compatibility with video devices: There are two approaches to supporting motion video hardware and software on the PC. The first, and oldest, approach is to have the authoring package or programming language support the devices through software "drivers" (a program that controls or simulates a hardware device). In this method the authoring package vendor produces drivers for each type of hardware they want to support. For example, if there are three common videodisc players that the vendor wants to support with their authoring tools, then they must write three programs that operate these videodisc players. The obvious disadvantage of this approach is that each authoring vendor ends up reinventing the wheel, and thus not all video systems are supported by any given authoring package.

The newer and more efficient approach to supporting desktop video on the PC architecture is through the Media Control Interface (MCI) of Microsoft Windows. This programming interface allows the video hardware or software vendor to write software programs that will work with any authoring package that works with the MCI software standard. The vendor simply has to write software that supports the MCI interface, and their software is independent of the video hardware and/or software configuration of the target computer. This approach removes the programmer from worrying about configuration issues on the target computers. All of the computer-based video technologies are supported through the MCI interface, although not all hardware vendors have MCI drivers for their older hardware. The use of the MCI interface assumes that the target computer is capable of running Microsoft Windows.

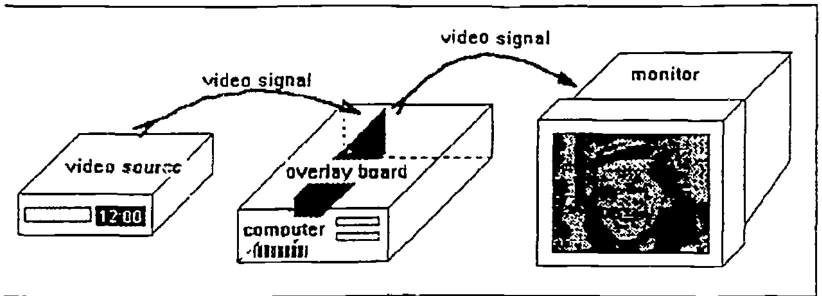

Figure 3. Schematic of analog video source and overlay board system.

User interaction with video: Another important issue of desktop video involves the amount of interaction the user can have with the video. Some video technologies do not allow for interaction with the video, and thus the user can only watch the image. For some applications this is all that is required, but for applications that call for the simulation of situations or equipment, it is desirable that the user be able to have some interaction with the video. Interaction with video is implemented by designing the software so that there are mouse- or touchscreen-sensitive regions on the video. This allows the program to control the video playback, based on user actions with the mouse, keyboard, or touchscreen.

Program control of video: Also important to the choice of a video technology is the amount of control that a program has over playback of the video segment. At the lowest level of control, the program can only play the video at normal speed in one direction, as is the case with broadcast television. At the next level of control, the program would be able to fast forward or rewind the video to a specific segment, and display only the video segments that were of interest. The highest level of control would allow the program to freeze specific frames of the video, adjust the speed of the video playback, reverse the direction of playing, or step through the frames one by one.

COMPUTER-BASED VIDEO TECHNOLOGIES

There are three classes of methods for displaying motion video on a PC. Each of these classes of computer-based video technologies includes several incompatible implementations, sometimes with only minor differences. The first method is to feed an analog signal, either from videodisc or videotape, into an overlay board, which combines the video picture with the computer-generated graphics. The second method is to use a computer with special video and sound hardware to present motion video on the screen. The third method is to use special software and a sound adapter card to process the video data and to display it on the computer monitor. Note that the first method uses an analog method to store the video data, while the second and third methods use a digital format to store and transfer the video data. This section describes the configuration, cost, fidelity, programmability, and suitable applications for each of these technologies.

Analog video

The first commercial technology to be used for computer-based video was the analog video source and overlay setup. The video is "captured" by transferring the analog video information from a source (a tape or camera) to the distribution media (either a videodisc or video tape). To play the video, the video signal from the video source is fed to the overlay board, which combines the video data with any computer-generated graphics, and feeds the output signal to the computer monitor, as shown in Figure 3.

The video source used in the majority of these systems is a videodisc player, because these offer a rugged distribution media and fast access to any point in the video material. Avideodisc is either an 8 or 12 inch plastic disk with the video and audio information stored as a series of microscopic "pits" inside the plastic. There are two videodisc standards: constant angular velocity (CAV) and constant linear velocity (CLV). CAV disks hold 30 minutes of video, allow freeze frame and variable speed play, while CLV holds 60 minutes per side, can stop at a given time in the video, and are best for non-interactive playback. Most newer players can play either type of videodisc.

Another analog video source, the computer-controlled video tape player, is becoming popular in applications that require the playback of long sections of video with little jumping around to other segments. These playback units are more expensive than videodisc systems, produce lower quality video, and have significant delays in moving to distant video segments. Since videotape does not require special equipment for duplication of the tapes, new tapes can be made quickly and cheaply. As with the videodisc player, the videotape player is controlled by the computer through a standard communication port.

There are two approaches to displaying computer-controlled video from an analog video source; video overlay and direct to television. In the overlay method, a videodisc is connected to the computer monitor through an overlay board, which allows the monitor to display the analog video source. This has the advantage of having the video,

text, and pictures on one display, but requires the extra cost of an overlay board. Another disadvantage is that while the quality of the picture from a videodisc surpasses that of consumer videotape, the overlay board and computer monitor looses some of this quality. The second, less common, method for displaying analog video is to take the output from the videodisc player and connect it directly to a separate television set. Although this has the added cost of the TV, this cost is usually lower than that of a quality overlay board, and the picture quality is higher.

Cost of analog video: Although the videodisc offers the best quality video, the cost per workstation is fairly high, because of the need for videodisc players (between $800 and $2500) and copies of the videodiscs at each workstation. A videodisc workstation also requires special video overlay and audio boards, or else requires a separate television monitor. The analog method is popular in cases where only a few dedicated workstations are necessary, and when the high video fidelity of videodisc is required. When a large number of workstations is needed, it becomes much cheaper to used digital video technology. As the price of computer systems, networks, and desktop video production continues to fall, the newer digital video technology will become more cost-effective.

One advantage of videodisc training systems is the large installed base of videodisc-based training computers. Many large companies have some type of interactive videodisc training center, and videodisc training has become a proven technology for teaching complex tasks. In cases where this is true, it may be cheaper to use this installed system than to use one of the other video technologies.

Fidelity of analog video: The most important advantage of videodisc is high resolution video and CD-quality sound. When the highest resolution of video or the best stereo sound is required, then analog video is the best choice. With a high-quality videodisc and a large television monitor for display, this technology approaches that of lower-quality film standards. The fidelity of analog video surpasses the quality of commercially available digital video technologies, although this is becoming less true as digital technology becomes more advanced and cheaper.

Programmability of analog video: Since the videodisc and overlay combination has been around the longest, a variety of authoring tools support this approach (although not all videodisc players are supported by all authoring tools). Because of the large number of videodiscs that have been produced, it is sometimes possible to find stock videodiscs that can provide small amounts of video to a computer-based video project. The videodisc also allows flexible access to motion and still pictures, random access in less than two seconds, and the ability to have four tracks of audio on a disc. This allows for multilingual versions of training software, or varying types of audio feedback that can be controlled by the computer.

One disadvantage of videodisc systems occurs in the production of interactive simulations. The problem is that the overlay board does not allow for the combination of multiple images, or the combination of video and graphics in the same area, so the instructional designer must predict and produce all of the video segments that will be needed before the final design of the system. For example, in the design of a nuclear power plant simulator, one would have to shoot videos with the switches in all necessary combinations of positions, and with all necessary display values. For a truly interactive trainer that provides realistic simulations of equipment, this would require large amounts of video, so in practice the simulation is constrained to a small part of the possible system states. With hardware-assisted digital video, this is not a problem, since several video segments can be combined, and video and computer-generated graphics can be mixed in the same area.

Appropriate applications for analog video: Because of the superior quality of the analog video and overlay board combination, it is the technology of choice when the highest quality video is needed. Such applications are those that involve visual inspection of objects, where the subject material contains fine detail, or when high quality is needed for marketing purposes. Because of the higher cost of the distribution media and associated hardware, this technology is not appropriate when cost is an important issue and the high fidelity video and audio is not required.

The consensus in the computer industry is that computer-based overlay video is on its way out, and will eventually be replaced by powerful compression hardware and high-capacity storage media (Fritz, 1993). This will happen as computer technology becomes more advanced, as standards are established, and the cost of digital video hardware begins to fall. But at this time there is no digital standard that can compare with the fidelity of videodisc. Overlay video also has the largest share of installed units and the largest amount of existing training courseware. Digital video standards do not have the maturity of overlay video technology, and it will be at least five years before digital will surpass analog in quality for a given price.

Hardware-assisted digital video

Another class of computer-based video is hardware-assisted playback of digital video. This method uses special computer hardware to handle the large amounts of data that are necessary for motion video. During capture, the video processor board converts the analog video signal to digital data, compresses the data, and stores it on the computer hard disk (shown in Figure 1). During playback, dedicated computer hardware is used to decompress the stored data (either from CD-ROM, hard disk, or network) so that it can be displayed on the computer monitor. The compression of the video allows for longer segments of video for a given capacity, and less data needs to be

transferred from storage to the computer. After the video data is decompressed, it is combined with computer-generated graphics and displayed on the computer monitor, as shown in Figure 4.

The de facto standard for this type of computer-based video is Digital Video Interactive (DVI) from Intel and IBM. DVI can be used either as a symmetrical video system, for lower cost, or as an asymmetrical system, for higher quality. In the symmetrical type of DVI, known as Real-Time Video (RTV), the video data is captured directly to the computer's hard disk at about 24 fps. This digital picture format can be used for still-frame pictures, or as "mock ups" to aid in system design and prototyping. Production of Presentation-Level Video (PLV), the asymmetrical flavor of DVI, is similar to that of the videodisc, in which the finished video material is sent to a processing facility for final production. During this final production stage, the high compression factors of DVI are obtained using specialized high-speed computers, thus allowing a CD-ROM to hold up to 70 minutes of high quality motion video. After compression, the resulting files are sent to a CD-ROM manufacturer to be mastered. Both methods produce near-VCR quality video, with FM-quality audio, although the frame rate and number of colors are higher with PLV.

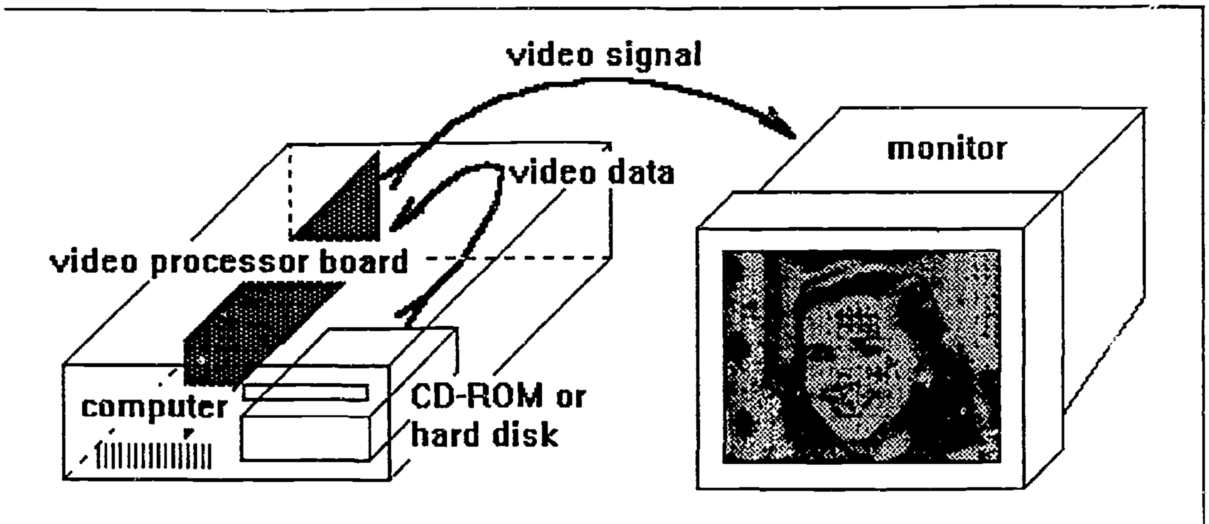

Figure 4. Schematic of a hardware-assisted digital video system.

In addition to DVI, there are several non-proprietary video standards that are coming out of the research lab. The first, JPEG (for Joint Picture Experts Group), was originally a standard for still pictures. There are several formats for displaying motion video that use the JPEG compression algorithm. The second standard, MPEG (for Motion Picture Experts Group), was designed specifically for motion video. The MPEG standard was designed with a 150 kb per second data rate in mind, as this is a common data rate for CD-ROM drives and local-area networks. Because encoding between the video frames is used to eliminate some of the redundant information, the data rate for MPEG is lower than that for JPEG (Jurgen 1992).

Cost of hardware-assisted digital video: Because of the extra hardware associated with this technology, this approach costs more than the software-only technologies, though less than an analog video system. Currently, DVI playback boards are expensive, at about $1600 for Intel's DVI board, the ActionMedia II. As with the cost of most computer hardware, the cost of digital video hardware is decreasing; Intel is now working on a $30 chip that will perform all the functions of the ActionMedia II board. In about two or three years, most new PCs will be equipped with some sort of video compression/decompression hardware in the same way that printer ports are currently designed as part of the computer, making it much more accessible to horizontal markets.

Another large cost associated with the DVI system is the final compression stage that is required to get both optimum playback quality and minimum file size. This compression can only be done by companies that have the special video compression equipment, and currently costs about $200 per minute of video. As digital technology becomes cheaper, this price will come down, and eventually this type of compression will be done on personal computers.

Fidelity of hardware-assisted digital video: Currently, hardware-assisted video technologies do not offer the quality of analog methods. This is because some of the sharpness of the original image is lost in the compression of the video, and the number of colors in the video is also reduced. Frame rates are usually above 24 fps, so motion in these systems looks fluid, and synchronization is also retained. Within any particular hardware-assist technology, there is usually some amount of variability in quality. For example, frame rate, window size, or audio quality can

be reduced, which will decrease the data rate and allow for more longer video segments for a give storage space. Thus the software designer can specify the desired fidelity (up to a certain point), and the fidelity and size of the files will be determined from this.

Programmability of hardware-assisted digital video: Because the DVI video is displayed by overlaying the motion video on the computer display, it is possible for programmed graphical buttons can be put on top of the video. This means that it possible to place controls over the top of the video. Overlays can be used to simulate the interaction with a device that the user is being trained to operate. Also, the DVI chips can be controlled by the computer, and can be used to generate dynamic graphics or interactive displays. Because the DVI chips are re-programmable, they can be configured to process other digital video formats, such as Motion-JPEG and MPEG.

The biggest problem with the Motion-JPEG and MPEG standards is that they describe algorithms, and not actual implementations. Thus, there are several incompatible file formats for these methods. This is because these systems do not fully describe a file format, and thus computer programmers are left to design this for themselves. As these formats become more widely accepted, de facto standards will emerge, but there have not been enough applications using these algorithms for this to happen.

Appropriate applications for hardware-assisted digital video: This technology is a compromise between the high quality of analog methods and the low cost of software-only playback methods. When the broadcast quality video of analog methods is not necessary, but software quality playback is not enough, this technology is a good choice. As the price of computer hardware decreases, the price gap between hardware-assist video playback and software video will decrease to the point where the cost is insignificant compared to the quality difference. At the same time, more powerful hardware will allow the quality of hardware-assisted video to approach that of analog methods at a fraction of the cost.

Software-only digital video

The only difference between the software-only digital video and the hardware-assist approach is that the computer's central processor is used to process the video data, instead of using special video processor of the hardware-assist approach. Both systems can implement the same decompression algorithms, but the difference lies in where the decompression is done. There are implementations of the Motion-JPEG and MPEG algorithms (both described in Section 4.2) that do not require special hardware for playback.

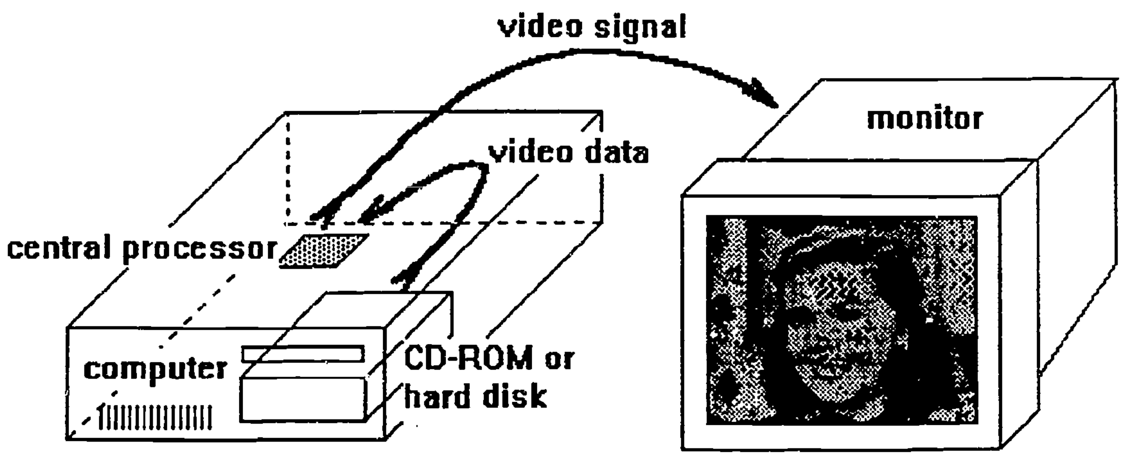

Figure 5. Schematic of a software-only video playback system.

During video capture, the analog video signal is fed into a "frame grabber" board, which captures up to 30 fps of the video, in much the same way that a film camera captures many still pictures on the film. The digital data is then stored on the computer's hard disk. Some implementations compress the data while it is being captured, while most require a separate compression step that reduces the amount of data in the video file. During playback, the computer software takes the digital data from the CD-ROM, hard disk, or computer network, and processes this data so that it can be displayed on the computer monitor, as shown in Figure 5. A computer "sound board" is required to process and play the audio track.

For the PC-compatible environment, there are several choices for software-controlled playback. The first is Microsoft's Video for Windows (VfW), released in December of 1992. The VfW standard is meant to be a low-price, software decompression standard for the IBM PC. For powerful 486 processors, the standard will support 15 fps

video in a 160 x 120 pixel window. Another software standard for digital video is the QuickTime for Windows system from Apple. QuickTime software was originally produced by Apple for the Macintosh computer, and has been adapted to Windows. This system has the advantage of cross-platform compatibility, since QuickTime software now exists for the Macintosh and for Windows computers. The Ultimotion system, from IBM, is compatible with Intel's DVI hardware, and can be used in either hardware or software modes.

Cost of software-only digital video: The capture board for the PC used to digitize the video signal can be bought for between $300 and $4000, with several boards in the $1000 range. This is usually a small part of the cost of the complete system, since none of the playback computers require capture boards, and there are no expensive mastering costs associated with this technology. In the case of VfW and Quicktime, the software required for the playback of video is free; all that is required is a program to tell the computer where and when to play the video.

Fidelity of software-only digital video: The quality of video is dependent on two factors; processor speed and CD-ROM (or hard disk) speed. If the CD-ROM does not support the required data rate (dependent on frame size, color depth, and frame rate), the player will start "dropping" frames, and the video will appear jerky. Similarly, if the computer has a slower processor or not enough available memory, the decompression algorithm will not be able to keep up with the data rate and will start dropping frames. In the worst case the audio track will also become fragmented. Thus the quality of the video will be proportional to the power of the computer; try to play a video segment on a low-end PC and the system is likely to drop video frames and produce choppy audio. Currently, most software-only technologies support only 256 colors, compared to the thousands or millions of the other systems.

Programmability of software-only digital video: Software-only playback allows full control of the video data; the video can be played in either direction and at any speed. The level of control is limited only by the flexibility of the software that is processing the video data. One disadvantage of most of these implementations is that they do not have overlay capabilities, and thus the programmer can not design the system so that the user can interact with the video.

Appropriate applications for software-only digital video: This technology provides the lowest overall cost of the three systems described in this paper. There are no mastering or hardware playback costs; usually all that is needed is one set of capture card and software. Playback of video does not increase significantly with the number of playback stations required, since only a CD-ROM player and sound board are required (and these can be used for other purposes). The tradeoff is in fidelity, since software playback gives the smallest window size, lowest frame rate, and least number of colors. Also, the computers being used for playback must be powerful enough to decompress the video: if they are not the audio and video will be choppy.

DISTRIBUTION MEDIA

The choice of distribution media is not independent from the choice of video technology. For analog video, the only choice for distribution media is between videodisc and video tape. The software and hardware versions of digital video can be distributed on either CD-ROM, diskette, or computer networks.

Videodisc / videotape

The videodisc and videotape formats are defined by their distribution media, since these are the only ways of distributing interactive analog video. If high quality video is required, then one of these methods must be used. The choice between the two will depend on fidelity requirements, expected usage of the video segments (short segments with frequent jumps vs. long segments of uninterrupted video), and cost constraints. Videodisc has the highest quality, is the most rugged, and allows for quick access to any point in the video segment. Videotape is cheaper per unit to duplicate, allows for easier updating of video material, and can hold up to six hours of video material.

CD-ROM / removable media

A single CD-ROM disk can hold about 680 Mb of data (about 325,000 pages of text, more than is in most encyclopedias). But without compression, the same CD can only hold a few hundred high resolution pictures or less than a minute of video. With compression, the CD-ROM can hold about 72 minutes of full-screen DVI video, or about 60 minutes of small-window VfW video. A big advantage of CD-ROM is the ability to hold several data types in addition to video, including text, sound, animations, and database information. Distribution on CD-ROM is best suited for large productions of data, and in cases where the data does not change frequently. When a smaller number of discs are needed, or the data changes frequently, the economies of scale of CD-ROM are lost, because of the expensive equipment that is required to manufacture them. Newer technologies allow the user to change the data on certain types of discs. This allows the system designer to distribute the data in a compact format, and to re-use the media after the data is outdated.

Diskette / hard disk

The largest installed base of distribution and storage media is the combination of diskette and hard disk, since most computers have both of these. The diskette is used to distribute almost all software, and this data is transferred to the hard disk for use on the computer. Diskettes are fairly inexpensive, are easy to duplicate, and can be re-used after the data has been transferred. This is the best method for distributing small amounts of digital video data. The biggest drawback with this method is the inconvenience of having to transfer data from the diskette to the computer's hard disk. Because of the large size of digital video files, several diskettes would be required for long video segments. For large amounts of video, or for video that is frequently updated, this would quickly become frustrating.

Computer networks

This distribution method differs from the others, in that the video data must first be transferred to a "server" computer that can send the data to other computers on the network. A computer network allows a group of computers to easily share data between themselves, and it is natural that digital video should take advantage of this technology. By allowing video files to exist on one computer instead of existing on each computer that uses them, cost is saved in the extra hardware (hard disks or CD-ROM players) that would be required without the network. For a large group of computers, the cost of the network is lower than that of the extra hardware for "stand-alone" multimedia computers. The biggest problem with using video on a network is the limited data transfer capability of current networks and the large data requirements of video. Some networks cannot manage these large amounts of data, while others may require special hardware to properly handle video data (Magel 1991).

CONCLUSION

Below is a chart that summarizes some of the issues of involved in choosing computer-based video technology.

	video overlay	hardware assist	software only
example system	videodisc & overlay board	DVI playback board and CD-ROM drive	sound board and CD-ROM drive
Costs:			
1. mastering[1]	$1800-2500 depending on type	$200/min. of video $1000-1200 for CD depends on number	$1000-1200 for CD depends on number
2. duplication (per station)[2]	$17.00 for < 100 $11.00 for > 1000	$1.40 for < 500 $1.33 for > 5000	$1.40 for < 500 $1.33 for > 5000
3. playback hardware/software (per station)	$800 - videodisc player $2000 - overlay	$400 - CD-ROM player $1600 - DVI board	$400 - CD-ROM player $200 sound board
Fidelity:			
1. frame rate	30 fps	30 fps	15 fps
2. number of colors	32,000	16,000	256
3. picture size	640 x 480	512 x 480	160 x 120
4. audio fidelity	CD quality	near-CD quality	near-CD quality
5. synchronization	perfect	good	good to poor, depends on computer
Programmability:			
1. compatibility	high	medium	low
2. interaction	medium	high	low
3. control	high	medium	medium

When choosing a computer-based video technology, the three important factors to consider are cost, fidelity, and programmability. The system designer must first determine how the video will be used in the application, including the content of the video, the fidelity required to display this video, how the video will be controlled, how often the video data will need to be updated, and the type and number of computers that need to be configured for video. From this data the designer can match the requirements of the applications against the capabilities of the various technologies, and choose a technology that meets these needs at a minimum cost.

[1] Assumes a 7 day turnaround; rates significantly higher for shorter times.

[2] Does not include packaging, which often costs more than the cost of the media.

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INTEGRATED BIOCHEMISTRY LEARNING SERIES (IBLS): A LEARNER CONTROLLED, MULTIMEDIA PROGRAM FOR MEDICAL BIOCHEMISTRY

Sharon E. Dennis and James Baggott

OVERVIEW

The Integrated Biochemistry Learning Series (IBLS) is a comprehensive program for the Macintosh which integrates all the topics of Medical Biochemistry into a flexible, student-controlled learning environment. It consists of four major sections:

1) Lecture sequences. The complete content of regular lecture sequences in the appropriate subject areas, including graphics and animation, sound, QuickTime movies, behavioral objectives and multiple choice and short answer questions for immediate self-testing.
2) Review tables in Intermediary Metabolism. Key information about intermediary metabolism is organized into a series of 81 tables which compare the similar, contrast the dissimilar, and arrange information in ways that provide visual patterns to assist learning. The tables are presented in a partly completed form; the user can practice filling in the missing information, or can reveal the correct responses if desired.
3) Multiple choice "Board-type" questions. The questions include feedback as to why the right answers are right and the wrong answers are wrong. All Medical Biochemistry topics are covered by this bank of 491 questions. Questions include an automated hypertext link to allow students to dynamically trace questions in similar subject areas.
4) Clinical problems related to the biochemical topics. These problems require the user to apply the information from the "lecture" material to solve a clinical problem with biochemical content.

These modules are completely integrated, so that students can use the program in a non-linear fashion. For instance, a student can instantly return to a pertinent lecture review while trying to solve a clinical problem or answer an examination question.

DEVELOPMENT

IBLS was developed by James Baggott, Ph.D., and Carol Angstadt, Ph.D., both Associate Professors of Biochemistry at Hahnemann University in Philadelphia, and Sharon Dennis, currently Head of Computer and Media Services at University of Utah. It was supported in part by the Health Sciences Libraries Consortium of Philadelphia, PA, in conjunction with The Pew Foundation. Development began in 1987 with the "Hemoglobin" module; today the program consists of lecture replacements for all the major topics in a Medical Biochemistry course. The program runs on a Macintosh under HyperCard 2.1 and takes up approximately 18 megabytes of hard disk space.

EVALUATION

The program has been an integral part of the Biochemistry curriculum at Hahnemann University since 1988. Students use the program in the Learning Resource Center at Hahnemann, or, increasingly, on their own Macintoshes. Interviews with students over the years indicate that most students find the program beneficial to their study. In particular, students find that the biochemical animations help "cement" difficult concepts in their minds. The practice examination questions are also a favorite of the students. A comprehensive evaluation project was conducted with last year's class. Students were asked keep detailed daily logs of total learning time, including lecture attendance and study on a topic by topic basis.

Computer use was recorded automatically by a record-keeping function of the computer program. Examination performance of every student on standard multiple choice questions was determined for each topic. Most students elected both to attend lectures and to use the computer modules. Conclusions from this study indicate:

1) 5% of the variance in examination performance is attributable to question module use. This is a surprisingly large contribution from a single, clearly definable learning activity.
2) The predictive ability of question module use even without statisticalcorrection for ability indicates it is valuable for both strong and weak students.

3) Lack of statistical significance for lecture module use indicates that IBLS use likely has no harmful effect, which would have appeared as a negative correlation. Computer-based learning may therefore be a viable alternative to traditional lectures. The lack of statistical significance for lecture module use may also be due to large differences among individuals in the population, and it is incorrect to infer that no effect exists (i.e., experience tells us that study time is a predictor of performance, but when many students with strikingly different abilities and study needs are averaged, no obvious pattern can be seen).

In addition to Hahnemann students, students at other Philadelphia medical schools have used IBLS. While the curricula at these schools does not match Hahnemann's exactly, the students have accessed the program by using a "Find" command to locate topics relevant to their study. And because IBLS is a HyperCard program, it can be easily customized to match the needs of other schools.

OTHER USES

Besides its obvious use as an instructional supplement, IBLS represents a large database of biochemical graphics (for printed documents) and animations (for lecture presentations). Dr. Baggott and Dr. Angstadt use the computer as a lecture presentation tool to favorable response from the students.

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INTERACTIVE MULTIMEDIA CAL AS A TOOL FOR HIGHER EDUCATION IN THE UK

Roger Beresford, Terry King and Dave Ross

ABSTRACT

An examination is presented of the features of interactive multimedia learning materials (on CD) which are most applicable to structures in Higher Education in the UK. The main focus of the paper addresses modes of learning and the impact of specific requirements software on leaming outcomes. A detailed critique of the problems associated with the introduction of such materials will be presented.

INTRODUCTION

In their recent research paper into the problems of introducing computers into University teaching in the UK, Hammond et al (1992) asserted that Computer-Assisted Learning (CAL) is 'about education, not computers'. Unfortunately, as this study pointed out, UK lecturers receive no formal training in educational theory and practice. They therefore tend to see educational technology as a replacement for existing tools, and CAL materials as a simple substitute for a lecture or text-based tutorial materials. This leads to an emphasis on the tutorial mode for CAL with the somewhat limited goals of fact acquisition and limited concept development.

The 'not-invented-here-syndrome' reflects how lecturers can view a piece of CAL software from the standpoint of where this will fit into their particular course without the understanding that they may have to move beyond the boundaries of conventional teaching methods towards radical educational change. Some success here has been by the creative exploitation of the capabilities of generic off-the-shelf packages (such as spreadsheets, databases, and computer imaging, as for example described by Cuttle et al (1993)), but Gardner (1990) still reported that the source of problems lay in 'shortcomings in educational theory, instructional design and curriculum innovation'. Because of the limited awareness of the potential of educational technology, lecturers in subject areas without recognisably technical content such as philosophy, or lecturers addressing the needs of senior students aiming at the development of higher cognitive skills often believe that computers cannot be applied to their subject.

To set a base line of what could be achieved, Marchionini (1991) reporting on a multimedia Project Perseus based at Harvard University deals directly with the wide range of pedagogical and cognitive skills which can be met by CAL software (Table 1).

1. Fact Acquisition
2. Concept Development
3. Rote Skill Acquisition
4. Attitude Development
5. Analytical Skill Development
6. Synthetic Skill Development
7. Interpretative Development
8. Metacognitive Skill Development
9. Information-Seeking Strategies
10. Problem Definition
11. Responsibility and Self-Discipline
12. Collaboration and Co-ordination

Table 1 : Leaming Goals Enabled by Interactive Technologies

The list of Table 1 illustrates the considerable potential that CAL material has for Higher Education in the UK.

INTERACTIVE MULTIMEDIA CAL AS AN ALTERNATIVE FOR LECTURES

There are two main categories of CAL project.

1. Those that attempt to place on a digital format pre-exiting courses or training material.
2. Those that are created especially for the digital platform.

This section examines the first of these options with a special emphasis on the considerations and criteria required to successful transfer existing material from traditional sources to a digital format. Much discussion has

been generated about how CAL in general, and multimedia supported CAL in this specific instance, should be evaluated, for example Pozzi, Hoyle and Healy, (1992) and Hutchings et al (1992). The main focus of concern in published discussion is why or how CAL is effective, not "How effective is CAL", especially in relation to other teaching/learning methods. In view of the small base of experience in the UK Higher Education sector this question has yet to be addressed in respect of multimedia supporteu CAL. A series of lectures is being developed as an interactive multimedia CAL resource using IconAuthor. This work, together with the student evaluation and subsequent modification, will be the subject of future publications, and presented as an interactive demonstration or poster session.

There are a number of reasons for wanting to transfer existing courses or training material away from the human contact environment to computer based training. Many of these reasons are primarily financial. CAL allows more people to undergo training whilst keeping costs at a fixed level. Many researchers cite increases in student numbers, a fall in staff time (Gardner and Munroe, 1992), constrained resources and the need for higher productivity (Barker and Manji, 1992; Leiblum, 1992) in educational institutions as the primary reason for researching new approaches to teaching/learning. In this context CAL, and now multimedia supported CAL, is a powerful method that, if used correctly, can provide effective pedagogic support.

The pressure on higher education establishments to increase student numbers whilst still maintaining a tight financial budget has precipitated a rush to embrace CAL. The responsibility has fallen mainly on the lecturing staff who have seen staff/student ratios increase steadily over the last few years. With this increase comes a need to reduce the contact time with students. It is therefore important that the contact the lecturer does have with a student is 'Quality Learning Time'.

The value of lecturing to a large number of students has been questioned in some quarters, but it is still the most common form of information exchange in higher education, Gibbs (1992). The ability to transfer the lecture onto a digital format would release the lecturer from the constraint of lecturing and allow them to complement the skills taught on the computer. The idea of transferring lectures to an electronic media, video or computer, is not new, but the fact that this is not yet a generally accepted approach needs to be examined. One notable successful user of video is the Open University, an institution in the UK that has for many years used broadcast lectures as the main teaching vehicle. All Open University courses are supported by tutorials and most by residential 'Summer Schools', where personal contact with a tutor is possible.

Firstly we need to look at the lecture as a form of communication, at worst it can be a laborious boring exercise for both student and lecturer, at best it can be a stimulating exciting experience. In truth most lectures fall somewhere between the two camps. But what is the lecture made up of? A good lecture is an eclectic mix of fact, opinion, anecdote, humour, reason, logic, and novelty.

The lecture is the tip of an educational iceberg, it should stimulate the student to explore the subject in greater depth, not just presenting the students with facts, but by exciting the student go out and investigate further the fundamentals that the lecture lays down. Students asked at a later date what they remember most about a particular lecture, rarely recount the facts that are espoused. Most lecturers know that many of the students remember the asides, comments and spur of the moment thoughts of the lecturer whilst the facts come down the list of memories. In short most remember the lecture performance.

A good lecturer gives a performance in front of an audience, and they respond best when excited by the enthusiasm of the lecturer. The problem then is to transfer the lecture performance onto a digital format.

All too many CAL packages have concentrated on simply placing the facts on the screen, this approach has in the past proved unrewarding and counter productive. The student becomes bored with the software and bored with the subject. In the end the student gives up on the software or at best ploughs through it to pass a test at the end. The stimulation is lost and the enthusiasm for the subject contained in the tradition lecture is replaced by textual tedium. Research has shown, (Winfield, 1986) that when using a VDU , a user's attention has only a short time-span and needs to be "re-engaged" if concentration is to be maintained. The learners attention can be engaged by animation, video, etc. (compare the very close attention paid to games screens by video game players) but this is helpful only if the presented material is directly supportive of the ideas/concepts being developed in the learner. One outcome in many situations is that the first activity of the learner, on being presented with new material, is to tryout all the buttons and effects without taking much note of the content. This is particularly true of material with a heavy bias towards knowledge acquisition, rather than engaging the learner in analysis, synthesis and composition.

Many students feel that computer based lectures are not real lectures, and that they have missed out on something by using a computer based lecture. We need to transfer lecturers in such a manner that the student feels the same kinds of emotions at the end of the computer lecture that they do at the end of a good traditional lecture. There are a number of techniques that can help this be achieved.

Most lecturers react to their students when lecturing and respond to student feedback as the lecture progresses. A good lecturer picks up from students indicators and student body language that tells them when a point hasn't quite been grasped or indeed when a point has been well taken and needs no further labouring. This is one area where the computer cannot compete directly and as such needs careful attention when being considered.

The lecture on computer can be seen very much as a production in the same way as a television of film production. Firstly the lecture should be analysed to ascertain the component elements. A story board should then be build, this will be a top level design for the digital lecture. The story board at this stage can contain simply the relevant points that the lecturer wishes to make during the lecture. Current work is being undertaken to refine the basic methods though the more commercial approach outlined in the various new texts on the subject, for example, Bunzel and Morris (1992) are obviously out of the question for individual lecturers or even departments, and would rely on a central production team, within the university or nationally.

PROBLEMS

As finance is one of the driving forces leading to the development of CAL, and now multimedia supported CAL, it perhaps surprising that financial problems are also significant barriers to its wider introduction. The cost of hardware resources, whilst continuing to fall in relative terms, presents a hurdle in many areas. The requirement is for the common availability of the necessary hardware platforms, not one or two specialist facilities.

Closely related to the provision of suitable hardware, is the provision of suitable laboratory space to accommodate both the student and the hardware. In the University of Portsmouth, Milton Campus, one currently acute resource limitation is teaching accommodation; a lecture room can hold far more students than the same room with multimedia computers. Small experimental provision to demonstrate principles is a long way from multimedia computing provision for all teaching facilities.

The availability of suitable software, and assuming a content free delivery system, the availability of courseware, is another significant limitation. Material can be developed in house by interested staff or students. Huckbody (1993) outlines three commonly adopted strategies for CAL or multimedia supported CAL production, by a single member of staff, by students on behalf of staff, by a team consisting of staff, students, and CAL resource specialists. Of the three the last seems to offer a better track record for success. There is a significant cost of production, Barker and Manji (1992) quote 100-300 hours of development time required per unit of delivered instruction.

Much of the work that has been finished to a state where the general student body, rather than selected evaluation groups, can make use of multimedia supported CAL, has been the result of large, nationally funded projects. Darby, (1993) reports the range of currently funded 'Teaching and Learning Technology Projects'. For example the MICROCOSM project at Southampton University, to implement a campus-wide structure for multimedia learning is typical. A key feature of the Southampton project is the use of a multimedia software platform, Microcosm, capable of integrating much existing material into a composite multimedia environment. Significant results from these specially set up research projects have yet to be translated into wider availability and use of multimedia technology by the commonality of students.

One project within the University of Portsmouth currently in the 'bid for funds' state is 'ViRTUE' - Virtual Reality Technology for University Education. The goal of this endeavour is to immerse the learner in a driven virtual reality to give a kinaesthetic and proprioceptive experience of simple physical situations. An example learning situation would be a seesaw where the learner can alter the basic laws of motion built into the simulator and get an integrated 'feel' for their effect. This would make use of a multimedia supported CAL system in conjunction with a virtual reality environment.

The large scale use of multimedia in Higher Education in the UK is unlikely to lead its wider adoption by industry and commerce. One apposite illustration of the precarious position of multimedia in the minds of industry movers and shakers is the UK launch of a well known multimedia component - in silence! The pace of development of multimedia hardware and software, and the resulting plethora of standards, is a significant limiting factor in its wider implementation and adoption, though with time this should stabilise.

Modes of Learning and the Basic Features of Interactive CAL Software for Higher Education

For computer aided learning (CAL) software to be suitable for Higher Education and meet the wider needs of lecturers, that software must promote all the higher levels of cognition described in Table 1. Also more recent research (King and Barker, 1992; Good et al, 1992) regards the issue of learner control of the learning process as of prime importance. Suitable CAL materials will exhibit the following characteristics to the learner:

1. DEEP RELEVANCE

As an extension of the idea of 'active learning' where the learner takes an active part in both the learning process and the creation of knowledge, Good et al. (1992) suggest that for CAL software to be relevant to the user's own learning experience, it must enable the learner to develop a sense of 'ownership' over their own learning process. Two factors which will give rise to a feeling of ownership are clarity of the learning process structure and ability to manipulate that structure, and choice of route to the chosen goals. This feeling of ownership is vital to engagement and a learning experience which is deeply relevant to the user. In a simple way, this feeling of ownership can be developed by explicit learning design which allows the tailoring of the content for the users own purposes. For example, by the ability to edit, abstract or annotate content or visual devices like 'paste on' notes etc.

However to achieve depth of relevance the software needs to develop in the user an awareness of possible goals and objectives in which the user can identify. The user will be able to identify with goals and tasks if they can establish their current cognitive position or level in relation to the total extent or potential offered by the software and then after reflection move to a point which is at an achievable higher level. Vygotsky (1978) developed the theoretical concept of the 'zone of proximal development' which suggests that once a user has established their own 'frontier' of knowledge they can move forward more confidently to a state which is just pitched a little higher with appropriate assistance. Using achievable goals provided by well designed CAL software, the user can build their own personal plan of achievement in this way. However, the CAL software must support the development of suitable self assessment protocols which guide learners in conducting assessments of their own learning processes (Marchionini, 1991).

2. ACTIVE LEARNING

The key to active learning is metacognition. The user must be encouraged to actively reflect on and contemplate the meaning of their own learning experiences and by analysing their own personal difficulties adapt their own learning strategies. This process leads to a constructivist approach where the user is actively involved in constructing their own learning by building new theories or revising existing ones. This process requires training and help. One source of help is through social interaction. In order to construct new knowledge, pre-existing knowledge must be challenged. This can be achieved through a challenging learning task, but an important way is through the challenge presented by the differing views of others and the reconciliation of those views. CAL software can be designed to utilise this approach through groupware, networking or conferencing.

With regard to groupware, CAL learning design can focus on the construction of group goals for learning, the facilitation of continued co-operation between members of the group, group assessment of needs and results (King and Barker, 1992). The Open University has explored computer conferencing through the development of a system which facilitates on-going conferences between students engaged on distance learning programmes. Successes include the ability of such a system to allow the sharing of knowledge between students, the inclusion of less confident students and the support they can obtain through tutors and students through the cloak of relative anonymity (Mason, 1989).

3. FLEXIBILITY

For software to offer flexibility the user must be in control of the choice of learning style. There are many possible ways of defining learning style (e.g. focused, browsing, guided, structured/ unstructured, shallow, deep etc.) but the basic division into single loop or double loop learning provides a useful focus. The first is about improving specific skills; the second about changing attitudes and behaviour (Good et al, 1992). Both have their place except that double loop learning can result in profound shifts; the kind of paradigm changes that can move the mental schema of a novice closer to that of an expert when pre-existing knowledge is explicitly challenged and restructured. Hypermedia systems have the potential to offer routes to both types of learning experience under the control of the learner.

While current hypertext products have shortcomings (Smeaton, 1991), the development of the node structures of hypermedia systems allowing complex routing, linked to the variety of resource available from compact disk (CD) and other technological advances such as digital video interactive (DVI) will enormously expand the possibilities for hypermedia to a level of complexity appropriate for Higher Education. Double loop learning requires a high degree of uncertainty which while stimulating and offering the possibility of a fundamental shifts in understanding is not always welcomed by the learner and may be avoided for reasons of timidity. To develop the high level of motivation required, software needs to be very engaging with a good interface and offer a high level of help and support.

4. QUALITY HELP

Software help systems vary but help can be effective in two ways. Firstly, help for the operation of the software. Such help can be global, for example, an initial section at the beginning which explains the operational rules. But help is most effective when provided in context (King and Barker, 1992). Another form of help can be provided

through ancillary learning support tools (like atlas, calculator, dictionary) or through the provision of specialist software (like spelling and style checkers, design tools etc.). For Higher Education essential tools should be linked to CAL software and freely available to the learner.

5. INTELLIGENT SUPPORT

If the user is to be supported in their active learning experiences and still be in control of the learning process then intelligent support can be offered to help the user to navigate through the software making real and personally relevant decisions about level, sections, routes etc. Each of these may lead in turn to single or double loop learning. Intelligent support can therefore be in the form of 'advisement strategies' when choices have to be made about routing or simple 'prompting' over options. This links with a more underlying form of support which can be provided by the monitoring of user responses. Vygotsky (1978) offered the concept of 'scaffolding' which is the temporary cognitive support that is offered to a student while they are in the process of movement between their base level of understanding to a higher level of achievement. This support is provided sensitively and can be removed or adjusted in stages. In the development of intelligent tutoring systems for Higher Education there is potential for intelligent support of this kind which is informed through monitoring the past learning patterns of the user.

6. AUTHENTICITY

A learning experience becomes real for the user when the content and experience is authentic. Authenticity is aided when the user can ground their learning in the transfer of existing skills, by the use of multimedia and the use of simulations and 'microworlds.' Cognitive learning theories suggest that active learning and motivation in learning are linked to the concept of relationship: that new knowledge to be learned must fit in with knowledge that is already held but also that cognitive conflict can arise. When skills or knowledge that are already held are applied to new situations, a more complex response is required which although perceived initially as demanding on learners can be the stimulus to deep learning. Adults or older students already have existing skills.

Authenticity of the learning experience with a piece of CAL material will depend on the extent that it encourages learners to realise both their existing skills and the extent to which these skills can be transferred to the new learning situation (Good et al, 1992). Multimedia features such as moving pictures from video or film, with sound, can not only add a high level of authenticity to studies of subjects dealing with interpersonal relationships and attitudes but it has been found that the treatment of subjects generally using such media can often establish motivation and higher levels of interest (Copeland, 1991; King and Barker, 1992) and increase learning gain through higher interaction (Scaffer and Hannefin, 1986). However, as research has shown that the benefits of the use of media depend on the level of skills in using media that are brought to the learning experience (Copeland, 1991), students would benefit from exposure to multimedia in its various forms from a wide variety of CAL software throughout their University career.

As a final issue, the processing power of modern desk-top computers now allows CAL software to go beyond interactivity to real-time simulation (RTS). Computer simulations, and RTS facilitate the development of intellectual structures, critical and analytical thinking and holistic learning, by creating environments which offer rich possibilities for discovery learning. The extension of RTS into 'microworlds' (Papert, 1980) produces a gaol space which has diversity, is very highly motivating, encourages self-directed, learner controlled exploration of a knowledge domain and using virtual reality techniques offers a high levels of authenticity.

CAL software with these six features would currently occupy the high ground of CAL development in the UK Higher Education sector, but it is doubtful if the widespread use of CAL, (with or without the addition of multimedia support) will become a reality until such features become commonplace.

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INTRODUCING MULTIMEDIA APPLICATIONS INTO THE CURRICULUM USING IBM TECHNOLOGY

Brian G. Scarbeau

Now, five hundred years after Gutenberg, fifty years into thetelevision age, and forty years after the introduction of thecomputer, we finally have in one tool the intellectual content ofprint, the images of video, the sensory impact of sound, and thespeed of electronics. David Shefrin, President, InteractiveVideo Industry Association

WHY USE MULTIMEDIA SOFTWARE?

Multimedia has been used as a communications tool for a longtime. The printing press has allowed us to use books forlearning for some time now. Television, films, slides and the VCR are still used as an instructional tool in many classes. Transparencies for overhead projection with elaborate graphs andtext is still another teacher tool used today.

Now, there is a broader selection of technology that can be usedto assist the teacher. Laser discs, CD ROMS, the usage ofspeech, music, digitized pictures along with the personal computer and new software that links all of this technology together.

Multimedia is an exciting new way to convey messages with thepersonal computer which allows you to mix a number of mediaincluding audio, video, text, numerical data, and graphics together.

This type of technology is ideal for educators who face theconstant challenge of trying to educate their students. teachers have been accustomed to using several teaching tools such as films, slides, overhead transparencies, white boards, black boards, flip charts, handouts, graphs, audio tapes, and more recently the computer to help the student learn.

What makes multimedia exciting to the student is the fact that it is interactive. Students can select different options from the computer screen and custom design their own learning. Teachers have the option of either designing their own multimedia courseware or select from several multimedia programs that is applicable to their discipline of study.

Students have the opportunity to experience historical events such as listening to Dr. Martin Luther King's famous "I have a dream..." speech while looking at a digitized picture of him. In addition, students have the opportunity to actually see and hear a heart beat on their computer. Animation allows the heart to move and digitized sound is created for the heart beat to be heard through speakers that are attached to the computer.

Multimedia will make a tremendous impact on the way students learn and the way teachers teach. Traditional teaching tools such as text books, films or television is not interactive. Students had no choices to make, but with multimedia, students can design their own path of learning along with the guidance of the teacher.

Equipment needed for multimedia.

Before purchasing any new equipment, decide what type of media will be effective in your presentations: digitized pictures, animation, speech, music, live motion pictures with a laser disc, CD ROM. If funding for your multimedia is limited, start slow. Buy only what you need to get started and add on to your multimedia inventory at a later date.

Before you start, do a physical inventory on campus of the equipment you might want to use for your multimedia project. Before buying equipment, find out if there is existing equipment that different departments might be using such as a hand scanner, flat bed scanner, that you might be able to use in your multimedia presentation.

Also, find out what departments would benefit by using multimedia applications and try to piggy back with them to get all of the equipment that will be needed to do multimedia. All departments will benefit by getting equipment that can be shared. Remember you only need to have a picture digitized or music created just once for your presentation and then the equipment can be passed along for some other department to use.

Finally, determine if the multimedia equipment will be for just faculty usage or will there be a course in multimedia offered to students. Communicate with other faculty members about your multimedia project. It's nice not to be alone in a new venture. Share your triumphs and your frustrations as well.

The more you time you spend in planning, the better organized you will be and you can get started with multimedia faster.

The following equipment is required to create and present multimedia:

Display: At least a VGA
CPU: At least a 386
Memory: At least 2 MB
Hard Drive: At least 60 MB
Mouse

The following equipment is optional and can be added on after you have learned how to use your multimedia software and determines what your needs will be:

CD ROM
Laser disc player
Motion peripheral card to display laser disc
Audio Capture and Playback peripheral card
speakers
microphone
Digitized camera
Video Capture peripheral card and software to digitize
Scanner
Touch Screen

Multimedia software allows you to be able to use a combination of media to enhance your presentation.

Phasing in new technology into the curriculum at Lake-Sumter Community College.

Lake-Sumter Community College started using multimedia technology in the Nursing Department with the utilization of an IBM Infowindow touch screen computer system along with a medical laser disc that students review. Two Sony laser disc players were purchased several years ago to be used with a Personal Computer Applications course that was used with students who wanted to study independently.

In the fall of 1991, a one credit course called an Introduction to Multimedia Computer Applications was accepted by the curriculum committee to be offered in the fall of 1992. This course will be an elective for students and offered by the Computer Information Systems Department. In addition, funding was approved by the SPD committee for all the necessary multimedia equipment.

The introductory multimedia course will cover the following topics: how multimedia technology is used today; what equipment is needed to do multimedia; how to use IBM Linkway multimedia software and how to design a multimedia application.

Lake-Sumter Community College had the necessary 386 IBM PS/2 equipment to utilize multimedia. IBM Linkway multimedia software was purchased along with the IBM M-Audio Capture and Playback Adapter card to be used for speech and music playback. In addition, audio speakers and a microphone were purchased.

At a later time, the necessary equipment will be purchased to digitize color pictures and create music files.

The first goal at LS-CC will be to integrate the Computer Information Systems, Music and Art department with multimedia. The Art Department currently offers a course called an Introduction to Computer Art. This course covers how computers are used in Graphic Arts and covers the usage of colors, screen designs, and animation using many popular software products.

The multimedia course offered in the Computer Information Systems Department will compliment this course and students who want to continue learning about multimedia should take this course.

Also, the music department wants to get involved with creating music using a keyboard, and midi interface. The music files created would then be used by students in the multimedia course.

Students taking the multimedia course will be required to create a multimedia project of their choice. A projects day will be scheduled so that administration, faculty, and students will have the opportunity to view the multimedia projects. If certain faculty like the multimedia project, they will have the opportunity to use that application in their class.

There are tremendous benefits of using multimedia in the classroom and new opportunities for both faculty and students. Interested faculty will have the opportunity to create and use existing multimedia applications that have already been created.

EXPLORING IBM LINKWAY MULTIMEDIA SOFTWARE

Linkway is IBM's version of hypertext tool for organization of information.

Linkway is multimedia software that allows the interfacing of:

Graphics, Music, Speech, Text, CD ROM, Laser disc.

LS-CC selected Linkway because the software was very powerful for the needs of the college and the price of the software is very reasonable.

The Linkway user first creates a folder which is a Linkway file. A folder is equivalent of a HyperCard stack. The program works with pull down menus, on screen buttons, pop up screens all selected by a mouse.

A folder contains pages. A page has objects on it like text, graphics, or a button. A button is an object that can go on a page. Each page is linked together in the folder to make the presentation.

There are seven buttons to select: Go, Link, Find, Text Pop-Up, Picture Pop-Up, Script, and Document. Each one of these buttons performs a certain task on the page they are located on. For example, a Go button when activated will advance to the next screen.

Linkway has its own paint program to create graphics screens for presentations. Digitized pictures can be modified in the paint program if necessary.

It doesn't take a great deal of time in learning how to create a Linkway folder. It comes with a tutorial that helps you understand how to create a folder, put pages into your folder, and how to put objects on the page.

All in all, Linkway will be a good investment for Lake-Sumter Community College's needs.

NEW PUBLICATIONS FOR MULTIMEDIA

NEWMEDIA AGE, $24.00 year,
Hypermedia Communications
901 Mariners Blvd.
Suite 2365
San Mateo, CA 94404

Digital Media: A Seybold Report, $295.00 year
Seybold Publications
Box 644
Media, PA 19063

Multi-Media Computing and Presentation, $349.00 year
Multimedia Computing Corporation
3501 Ryder St.
Santa Clara, CA 95051

Mind over Media, $175.00 bimonthly
Multimedia Computing Corp.
3501 Ryder St.
Santa Clara, CA 95051

Media Letter, $395.99 yearly
P.O. Box 142075
Coral Gables, FL 33114

New Media Products, $250.00 yearly
330 Distel Circle
Suite 150
Los Altos, CA 94022

Bove and Rhodes Inside Report on Desktop Publishing and
Multimedia, $195.00 yearly
Bove & Rhodes
P.O. Box 1289
Gualala, CA 95445

MULTIMEDIA PROFESSIONAL ORGANIZATIONS

Interactive Video Industry Association
800 K Street N.W.
Suite 440
Washington, DC 20001

MULTIMEDIA TERMINOLOGY

Advanced Interactive VIDEO (AIV) - Interactive videodisc format and system using LV ROM, a method of storing analog videos, digital audio, and digital data on a single videodisc.

Asymmetric system - A video system that requires more equipment to store, process, or compress a digital image than it needs to play that image back. Intel's Digital Video Interactive (DVI) system and the PhilipsSony CD-I system are asymmetric in their full fidelity modes.

Authoring system - Specialized computer software which helps its users design interactive courseware in everyday language without the details of having to program the computer.

Board - Peripheral attached to computer mother board slot. Examples: CD ROM card must be plugged into one of the vacant slots on the mother board.

CAV and CLV - The two main ways of recording video on videodiscs. CAV (constant angular velocity) method, the rotation speed of the disk stays constant, while the CLV (constant linear velocity) method, the rotation rate changes to keep data on the disk passing the laser pickup at a constant rate. CAV videodiscs are capable of random access and therefore are the type generally used for interactive multimedia applications.

CBT - Computer Based Training- The use of computers for interactive instruction.

CD-I - Compact disc-interactive-a standard for CDs that lets you integrate data, still graphics, audio, and motion video on the same disk.

CD-ROM drive or player - A device that retrieves data from a disc pressed in the CD-ROM format. CD-ROM drive or player can be built into the computer system or external.

Compact Disc (CD) - A 4.75 inch (12 cm) optical disc that contains information encoded digitally in the CLV format.

Courseware - Instructional software including all discs, books, charts and computer programs necessary to deliver a complete instructional module of course

CPU - Central Processing Unit. The cpu or brain of a computer system, in which all calculations, instructions, and data manipulations are performed. It contains the main storage, arithmetic unit and special register group. Also called the microprocessor. At least a 386 CPU must be used for multimedia applications.

Delivery system - The set of video and computer equipment actually used to deliver the interactive video program. A delivery system may comprise as little a videodisc player connected to a computer system or external speakers, CD-ROM player, and a videodisc player connected to a computer system.

DVI Digital video interactive - Intel Corporation's proprietary technology for putting full motion video on Cds and magnetic media at a very high level of compression.

Frame - A single picture in a video recording

Full motion video - Video sequences or systems that provide enough images per second to afford the illusion of smooth motion.

Graphics - All visuals prepared for production.

Hardware - The electronic equipment used for processing data.

HyperCard - A Macintosh software product developed by Apple Computer Company. Using the philosophy of hypertext, the program enables users to randomly organize information in a manner like that of his/her own thinking.

Hypermedia - An extension of hypertext that incorporates a variety of other media like audio, video and graphics.

Hypertext - The concept of non-sequential writing which allows writers to link information together through a variety of paths or connections. Hypertext allows users to seek greater depths of information by moving between related documents along thematic lines or accessing definitions and bibliographic references without losing the context of the original inquiry. The term was coined by Theodore Nelson in the early 1960's.

Icon - A symbolic, pictorial representation of any function or task.

Interactive - Involving the active participation of the user in directing the flow of the computer or video program; a system which exchanges information with the viewer, processing the viewer's input in order to generate the appropriate response within the context of the program.

Kiosk - This is the housing for an unmanned, self-contained free-standing interactive system that is generally located in a public access area.

Laser disc - LaserDisc is a trademark of Pioneer Electronics USA for its reflective optical videodisc products.

Linkway - IBM multimedia software program that combines text, graphics, pictures, music, voice and full motion video interactively.

M-Audio Capture and Playback Adapter/A - This peripheral card by IBM provides digital recording and playback of high quality stereo sound used with Linkway Multimedia Software.

M-Motion Video Adapter/A - This adapter peripheral card by IBM delivers full motion video and audio on an IBM PS/2 Micro Channel System. Video is digitized and can be displayed full screen or in multiple windows; sources include video discs, video cameras, and VCR.

Multimedia - A presentation or program that involves the use of multiple media data types such as audio, video, graphics, text, and natural images. Multimedia involves different media sources operating under computer control.

Multimedia system - A computer based system capable of processing and displaying multiple media data types such as audio, video, graphics, text, and natural images. Such data types may reside on the same data storage device or may come from different source media such as CD-ROM and videodisc.

Overlay - The facility to superimpose computer generated text or graphics onto motion or still video.

RS 232 - A standard serial interface between a computer and its peripherals. Connection between laser disc player and computer.

Scanner - Peripheral attached to the computer system that takes an original picture and then scans it into the computer system that then can be saved in a graphics format to be used in a multimedia presentation.

Symmetric system - A video system that is capable of both storing and playing back compressed digital images.

Touch Screen - A video or computer display which acts as a control or input device under the physical finger touch of the user.

Ultimedia - IBM's family of multimedia computer systems and products. The term refers to IBM's interpretation of multimedia as being a sum of three revolutions wrapped into one-a revolution in communications that combines the audiovisual power of television, the publishing power of the printing press and the interactive power of the computer.

Video - A system of recording and transmitting information which is primarily visual by translating moving or still images into electrical signals.

Videodisc - A generic term describing a medium of information storage which uses thin circular plates of varying formats, upon which video, audio, and data signals may be encoded for playback on video.

Windows - An operating system by Microsoft Corporation that allows the user to do multitasking. Accomplish more than one task using different software programs.

Excerpted from Videodisc and Related Technologies: A Glossary of Terms.

MULTIMEDIA PUBLISHERS

McGraw-Hill/Datapro has repackaged and published, in multimedia fashion, some of the information contained in its computer hardware and software, print media and products directories.

ABC News Interactive has published interactive video disk documentaries.

Time Warner New Media has introduced a multimedia version of Mozart's Opera "The MAGIC FLUTE".

National Geographics has published a geohistory of the United States that combines stills from National Geographic's photo library with narrative, text and illustrations.

Grolier Electronic Publishing has published a multimedia CD of its encyclopedia.

Encyclopedia Britannica has a similar version of Compton's Encyclopedia with illustrations, and audiovisual animation sequences.

The Harvard Business School plans to issue a series of multimedia programs on management issues.

Robert Abel, an independent producer of television commercials, has created GUERNICA, a prototype multimedia documentary that covers the life, works, and times of Picasso.

Palenque is a pilot program developed by the Bank Street College of Education. It takes the user through a travelogue of ancient Mayan sites, using text, still pictures, audio, and video images.

The Children's Television Workshop, better known as Sesame Street, has developed a pilot program called Words in the Neighborhood. Designed for pre-schoolers, this multimedia venture links a video wordbook with footage taken from the Sesame Street TV show.

Several companies are now experiencing the power of multimedia. Companies as diverse as Bethlehem Steel, DuPont, General Motors, Domino's Pizza, Coca Cola, General Telephone and Electric, Arthur Anderson, General Electric, IBM, Ogilvy & Mather and Steelcase have begun to use multimedia in corporate training, reporting, promotion, and analysis programming. Companies are taking advantage of live motion video, sound, still pictures, clear graphics and an easy input device such as your finger on a touch screen to create kiosks to house the computer hardware equipment.

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MEDIA FIELD TRIP TO A ROCKY INTERTIDAL ZONE

Raymond Russo

INTRODUCTION

Computer simulations have become very common in the sciences. They allow students to study phenomena that may be difficult or impossible to view in reality. However, the majority of these simulations have severely limited the user interface to entering words or numbers into the simulation and receiving graphs or tables designed by the software developer. These restrictions on the user interface have limited the reality of the simulation and reduced the opportunity for the student to learn methods of experimental design and data analysis. With the development of computer-controlled devices, like the videodisk, CD-ROM, head-mounted video goggles and the data glove, other modalities became available to the developer to create a more realistic user interface. The trend in computer simulations is towards "virtual reality". But these advances are superficial if they are not merged with pedagogical goals that teach higher cognitive skills.

MULTIMEDIA SIMULATION OF THE INTERTIDAL ZONE

This paper describes the current state of development of a multimedia simulation about the rocky intertidal zone of the Pacific Northwest. The simulation is designed to allow a student to accomplish two primary goals: 1) allow a student to "visit a site" which is exotic and unlikely to have been visited before and 2) teach students how to design and analyze experiments through successive trials making incremental improvements in each resolution. The simulation allows investigations on organisms living within the intertidal zone at Friday Harbor Labs, the marine lab for the University of Washington. Very few undergraduates have had the opportunity to study at a field station, especially a marine lab, and most are attracted by the beauty and uniqueness of the Pacific Northwest. Among the cognitive skills which need to be developed in future scientists are experimental design experiments and data analysis. However, experimental design is a very dry topic when disconnected from the biological phenomena that led to the investigator's question. Our simulation teaches proper experimental design by beginning with relatively simple experiments that are descriptive and moving the student towards experiments which manipulate several independent variables simultaneously and with the appropriate number of replicates and multiple controls. There are several ways for an instructor to use this simulation. If the instructor would like to have the students exposed to the complete set of problems and experiments, they should plan on the students following the "Scenario." In the scenario, the student receives a grant from a research foundation and must navigate his way to Seattle and the marine labs located on the San Juan Islands located in Puget Sound. Along the way, there are many opportunities to explore the area around Seattle and the San Juan Islands in Puget Sound. Eventually, the student arrives at Friday Harbor Labs. The student has an exact map of the grounds of the Labs where he/she may enter any building by clicking on it. The instruction in experimental design begins with a simple request by the director of the lab to identify the organisms that live in each band of the intertidal region, the zone between the high and low tide marks. The simulation builds through a series of problems that increase in difficulty and culminate with the student conducting experiments on the factors affecting the distribution of the important species in the intertidal zone.

Another way to use the simulation is for the instructor to limit the assignment to a single experiment that is appropriate to the student's level. In this case, the student would use only a part of the simulation and would avoid much of the general information that is provided in the other approach. A student could complete a single experiment in one or two sessions.

FEATURES OF THE SIMULATION

To increase the information content and reality of the simulation, we have developed a series of features to give the student control over what he/she leams and the rate that he/she explores.

The first feature is a series of information rich maps used by the student to navigate to a specific location and explore the area. We created a set of maps that increase in scale allowing students to explore the Puget Sound area, the San Juan Islands, the village of Friday Harbor, and the Friday Harbor Labs grounds. The student explores these areas by rolling the mouse over the map. As the browse tool (the hand with pointed finger) passes over each attraction, a short description appears in a text box in the corner of the screen.

Locations marked by an arrowhead or diamond enclosed in a white circle activate a view from that point. The arrowhead denotes a single still image looking in the direction that the arrow is pointing. A diamond enclosed in

a white circle denotes a navigable scene. By clicking on the white circle, a navigable scene is shown in a window superimposed upon the map. Above the picture is a set of controls that allows the viewer to pan to the left or right. Most navigable scenes allow the student to pan a full 360, just as if they would turn around to view their complete surroundings. When the student has satisfied his curiosity by "looking around," the window is closed returning the student to the map to explore other locations. When the student is ready to explore the next map, he clicks on the name of the place that he wants to go. There are about twenty navigable scenes on each map. A hierarchy of three maps allows the student to gradually converge on the Friday Harbor Marine Lab.

A third feature of the rocky intertidal zone simulation is that the student is actively involved in doing the experiments. From the collection of organisms to the collection of data from the complicated experiments, the student continually interacts with the computer. We have paid particular attention to the design of the user interface for these activities. The student works with tools that are already familiar. As a student undertakes a task, he/she sees the object or habitat he/she is working with. As the task progresses, the student uses the mouse to guide the pointer that has been changed to look like the real-world tool that would accomplish the task. For example, after arriving at Friday Harbor Labs the student is given the assignment of collecting as many different kinds of organisms that can be found in the intertidal zone at Cattle Point. The low tide will occur at 10:14 am. Cattle Point is the southern most point on San Juan Island. The collection task opens with a panoramic view of Cattle point extending from High tide to the lowest tide level. The pointer is an open hand which "grasps" when the mouse button is depressed. If an organism exists at the location of the grasping hand, the pointer changes into a miniature image of the organism. The student drags the organism to the collecting bucket and releases the button allowing the organism to drop into the bucket. Different organisms are collected from different zones. Early tests of this interface have shown that the most students understand how to operate the tool quickly without any verbal instructions. However, they usually fail to recognize exactly where they are collecting from. This is not a serious handicap to the problem they are working on, but it would be an aid to designing experiments later in the simulation.

After collecting several organisms, the student returns to the lab where he can keep the collected specimens alive in the salt water aquariums. The student navigates around his lab using a floor plan of the lab. Some of the tools he/she will come across are an observation aquarium, a dissection microscope, refrigerators, and an equipment storage room. He can use any tool in the lab by simply dragging the organism to the tool. For example, he can view the organism in an observation aquarium by dragging the organism from the holding aquarium to the observation aquarium. For close inspection of any organism, he/she drags the specimen from the holding aquarium to the dissecting microscope. He can manipulate the organism under the scope by rolling it in any direction. The result of each adjustment is a view of another side of the organism. The storage room contains a variety of equipment that can be used to exclude predators or competitors from the substrate in experiments in the field. We have created a "virtual marine laboratory" for the student to use to interact with the simulated environment.

The identification of the organisms can be accomplished in a variety of ways. The student may go to Femald Library and check out an identification key or picture book about fauna of the San Juan Archipelago. The library contains three full hypermedia texts with color pictures, explanations of intertidal organisms and descriptions of their ecology. The library also has a reserve shelf with a set of ten original articles by authors who conducted experiments in the rocky intertidal zone. If a student prefers verbal interaction with established investigators to identify the organisms, the students may enter any of the other labs on the grounds of Friday Harbor Labs. There are about 15 senior investigators that a student may interview to help identify and leam about the organisms collected.

EXPERIMENTATION

The primary pedagogical purpose of the simulation is to teach the student how to design experiments. We have selected three types of studies typically conducted by biologists through which to teach experimental design. The simplest study is descriptive in nature where the investigator determines what organisms live in the habitat by learning to identify them. The students are told of several ways to identify the organisms that they collect. We encourage them to first identify them to taxonomic class by using morphological characteristics. They can use either an identification key or a synopsis of intertidal invertebrates from the library. They may also request the help of Investigators who are working at the labs. The summarizing activity for this problem asks the student to correctly classify 16-20 organisms that are found in the intertidal zone.

The second type of study is one in which the investigator describes the pattern of distribution of the organisms of interest and determines their density. This is begun by the director pointing out to the students that there seem to be distinct bands within the intertidal zone. This becomes obvious from the general coloration of the intertidal zone. The bands are parallel to the water line and are created by the organisms living within each zone. The

student identifies the composition of each zone by more careful collection of organisms using rectangular plots. Four transects are available to sample. Each transect is composed of between 8 and 18 one square meter high-resolution photographs. The density of each species within each band can be determined by the student counting the organisms that appear in a high-resolution photograph of the plot. Note that the student must "do" the actual work of counting. The act of counting organisms is more than just counting. A person must repeatedly identify each organism before he can count it. Since we supply the data in picture form, the student must perform the same activity that an investigator would have to do in reality. This analogy between reality and the simulation increases data collection skills as well as analysis skills. The summarizing activity for this problem is that the student must report back to the project director the density and range within the intertidal zone of four dominant sessile organisms. In order to reduce the work, the students can collaborate with other individuals and report the same kind of information for other species.

The third type of study is one in which the investigator manipulates one or more factors that is suspected of limiting the distribution of one of the dominant organisms. The director of the lab poses the question "What factor limits the upper and lower boundary for a particular species?" The student now must design an experiment that would provide an answer to the question. The design of experiments is not a trivial task because it includes the synthesis of habitat-specific information with previous knowledge of biology to lead to some suspected cause of a phenomenon. Our intention is to help the student recognize the most likely factors that limit the distribution of organisms. Some of the factors that we allow the student to investigate may have little or no effect upon the distribution of most species, but will be important to one species or guild. These experiments usually begin by the investigator creating or modifying a piece of substrate to create one combination of the independent variable(s) of the experiment. For example, if the student wanted to determine the density of Balanus glandula, an acorn barnacle, at mean tidal level in the absence of Balanus cariosis, he/she would select a plot of substrate at mean tidal level and remove all of the Balanus cariosis, leaving only Balanua glandula. The student creates this experimental treatment by using a chisel tool to remove B. cariosis. The student also must create other treatment combinations of the independent variable(s) that form the experiment, including a control treatment. In this case the control would be to leave both species of barnacles on the rock. When the initial treatments are set up, the student uses a time machine to select a time in the future when he/she would like to see the experimental substrates.

The approach we are taking to provide the greatest flexibility in allowing the student to study any factor of his/her choice is to build a bottom-up model of the dominant organisms living within the intertidal zone. Artificial life or automaton (bottom-up) modeling has emerged recently as an effective tool for creating complex systems by developing a relatively simple set of rules describing how a species interacts with any other species and the conditions of its immediate environment. If we have correctly described each rule for all of the species, the non-linear interactions of organisms create communities that will exhibit community level phenomena, like zonation.

The experimental result of a particular treatment combination is a picture, actually a collage, that is composed of images of individual organisms located in the pattern that they would be found on the substrate. The student collects data from this experiment by examining the substrate that experienced each treatment. The student will have to decide how to quantify the data by counting or measuring something in the picture. The purpose of this form of output is that we believe that part of the training of an ecologist is to decide how quantification should be done in this particular experiment. Students must compare several dependent variables and select the one method that suits their needs. Counts and measurements of each species tells the story of what the treatment combination caused.

Our automata model will allow the student to investigate the effects of at least six different factors on any of the dominant organisms living within the intertidal zone. Specifically, the student can investigate the effect of the following factors: 1) Temperature-desiccation, 2) Log damage, 3) The density of the large predator guild (two starfish species), 4) The density of the small predator guild (predatory whelks), 5) the density of a competitor guild (any of three species of barnacles and one mussel) 6) the density of the disrupter guild (limpets and chitons). These factors, both biotic and abiotic, can affect the density of the following dominant species: 1) Barnacles (Chthamalus stellatus, Balanus glandula, Balanus cariosis), 2) Some types of algae (Endocladia and Ulva), 3) a mussel (Mytilus edulis), 4) the limpets (Tectura scutum, Lottia pelta, Collisella digitlis, Acemea mitra).

The summary of this exercise occurs when the student must identify the factor that limits the distribution of the dominant organisms in the intertidal zone. The summary requires that the factor not only be named, but that the conclusion be supported by experimental evidence.

CONCLUSIONS

We have described the current state of development of a multimedia field trip to a marine biology station on a rocky coast. The simulation combines the best of arcade games with the richness of information provided by the real experience. We have used several new interface paradigms to give the user more control of what he sees and does. Finally, we have provided a way for the student to investigate the effects of various factors on the dominant organisms living in the intertidal region to account for the bands that appear in this zone.

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MEDIALINK: A NEW METHOD FOR AUTHORING MULTIMEDIA LESSONS FOR THE CLASSROOM

Robert L. Oakman, Jay A. Waller, and Fred Fenimore

In 1990 our software development group at the University of South Carolina completed LiveWriter, a networked collaborative writing program for Macintosh that allows teachers to look through the network and work directly with students in their papers. LiveWriter provides an instructional shell with the lesson content to be decided by the teacher. Teachers can log onto student files, comment on the work in a message window, and even revise or correct the student paper while they are in contact. The program also allows for peer editing with students working with their colleagues. LiveWriter has been well received by teachers at all levels from third grade through university and was a finalist in 1991 for an EDUCOM Higher Education software award.

Growing out of this work and the ability to record and distribute digitized sound files on Macintoshes, in 1992 we introduced a second program called LanguageWriter, primarily for the teaching of foreign languages. This program allows teachers to prepare coordinated text and sound instructional materials of their own design. Instructors can record their own digitized sounds, relate the sounds to written text, and save the results in a lesson format. Students can then later access the lesson, containing both sound and text, on a computer network. They can select words or phrases and play back the sounds corresponding to their selection. They can record their own voices, compare their speech to the instructor's, or answer questions in written form. The program expands the notion of teacher/student interaction implicit in LiveWriter to allow flexible combinations of text and voice communication for language instruction. It expands the concept of networking as an educational tool by offering the classroom teacher multiple modalities with coordinated text and sound data for personalized lesson development.

Current ideas of computer pedagogy stress the success of interactive video. For instance, in foreign languages students can replay segments of real television or videotape on the computer and simultaneously be presented language materials to test mastery of native-speaker dialogues and interactions. In fall 1992 we began to consider new extensions to LanguageWriter using Apple's QuickTime to integrate digitized video with the text and sound capabilities of the program. In the process we realized that we might as well include digitized photography and graphics. In effect, we were building on the foundations of LanguageWriter to make it a full-fledged multimedia tool for lesson preparation. The result is called MediaLink, a flexible, easy-to-use multimedia tool kit for teachers to make up their own lessons in all of the standard media that modern Macintoshes support.

Computer-assisted instruction typically is of several types: drill and practice, which students often find boring; simulations and exploration systems, which, if done well, allow students to move around in a richer learning environment; and authoring tools containing no content but suitable for development of courseware in many fields. The key to the success of the latter is having good course content and building a lesson at the right level for student ability and interest. Where our earlier software projects have been most useful, teachers have seen the capabilities of the authoring environments for interactive writing and multimedia language instruction (digitized voice and text materials) and have developed their own lessons.

The interface for lesson design is intended for ease of use for classroom teachers who do not need to become software specialists. It does not take a lot of previous computer experience to use our software. In fact, the first teacher to test LanguageWriter with lesson materials in German had never turned a Macintosh on or used a mouse when she began. Within forty-five minutes she had learned how to use the program and prepared a short German lesson for student testing. On the other hand, to use a present-day word processor like Microsoft Word Version 5, a person really needs to be familiar with word processing fundamentals, because this program has been so updated with features that one can experience information overload in initial contact with the program.

MediaLink is built to include and expand on the several pedagogical successes of our earlier software projects. Important features of our original software design have not changed with MediaLink: individual teacher control of lesson format and content; a flexible, user-friendly interface for the teacher in lesson preparation; and a hardware base of low-priced Macintoshes so that low-budget instructional departments such as English and foreign languages can afford to use the tool.

What kinds of projects might be suitable for lessons using MediaLink? Let us assume that a German teacher wanted to produce materials based in map reading skills involving places and terms on a map of the new Germany. All instructional tools must be prepared as separate computer-readable files before they can be integrated together. First the teacher could use a scanner to digitize the German map and perhaps need to enhance the image with additional place names or technical terms with a graphics software package. MediaLink does include facilities for

creating text and sound files; but pictures, graphics, animations, and video movies currently must be prepared outside the program. For the map a scanner would be appropriate, and a video board for capturing a movie as a computer file in QuickTime format. Then the teacher could compose a series of questions for the students to answer as they view the map. The instructions might want student response in both written and spoken form.

For instance, the student might be asked in what state is Leipzig located. The answer of "Sachsen" (Saxony) is to be recorded and typed back by the student in a properly-formed complete German sentence for later checking by the teacher. Further information about daily life in Leipzig available from the German information agency on videotape could also be stored as a QuickTime movie, and further probing questions about the content asked of the students in the text window.

At this point the teacher has three files to integrate into a lesson: a set of written questions, a map, and a short video. All are just windows of information as far as MediaLink sees them. Two other windows need to be created as the student works with the materials: a writing window for typing the sentence answers to the teacher's questions and a sound window for recording the sentence answers. Ready to create the lesson, the teacher links the map window with the question window, since the questions refer to the map. At the reference to Leipzig in the text questions, the teacher also drags the video file and highlights the word "Leipzig" so that the student can click on it and open the video for viewing at the appropriate time in the lesson.

The software incorporates the feature of graphical user interfaces called "drag and drop," which in this application is applied to hypermedia linking. We chose this method for linking files because of the minimal learning time involved in using it. People familiar with Macintosh or MS Windows are already accustomed to picking up files in windows and moving them around by dragging the mouse. When the teacher drags the map window onto the text questions, the link is set that the map depends on the questions and should be shown with them. Similarly when the student clicks on the word "Leipzig," the movie window is opened because the teacher dragged the movie onto the word "Leipzig" in the text window. With the window open, the student can then play the movie as many times as necessary to answer the questions about it.

At this point MediaLink, as described, is basically an easy-to-use hypertext tool for construction of multimedia lessons. It offers no features for collaborative work--the LiveWriter paradigm of shared files in an interactive writing class--between teachers and students or among students in a networked classroom. In fact, authoring tools like Authorware for Macintosh share similarities with MediaLink in this ability to create lessons in various media. We hope, however, that the ease of lesson development with the "drag and drop" convention of linking windows is a very strong attraction of our software. Meanwhile, the student may be asked to look at the Leipzig movie with a colleague and develop a joint report in German on some aspect of the materials shown there. Currently under development, this feature of MediaLink will incorporate the networking capabilities of LiveWriter.

Students can find the active users of the networked classroom and drag their writing windows on top of one of their colleagues. That student then gets a message on the screen that the originating student wants to set up a conference. They can then begin an interactive dialog. Perhaps each takes time to watch the Leipzig movie, and then together they begin to compose their report in a new writing window. Also available to each of them is a message window in which to discuss what they have seen in the movie and the best way to fulfill the assignment in their written report. In effect, the multimedia learning environment can become a collaborative effort with this feature of MediaLink. LiveWriter has been one of the few writing tools that support collaborative work, and including its networking functionality into MediaLink enhances the pedagogical potential for the new software tool in creative ways not available in other programs.

Pedagogically MediaLink in its current form provides teachers with a generic, flexible authoring tool for preparing content materials of their choice in all of the four media--text, sound, pictures, and movies--rather than those prepackaged by others. It is designed to be easy to use for lesson preparation and for active usage in the networked classroom. By contrast, hypertext instructional authoring tools such as Hypercard and Toolbook require more investment in teacher time to become proficient in authoring, and consequently lessons prepared with these programs in use in most schools today are ordinarily preprogrammed for content by the designers. The combining of multimedia capacity and collaborative editing on a popular, low-priced Macintosh broadens both the concept of delivery of materials and the idea of teacher-student and student-student interaction to produce an affordable educational tool applicable in most areas of instructional pedagogy. And, most importantly, it is all under the content control of the classroom teacher.

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MULTIMEDIA ON A SHOESTRING

Michael J. Payne

ABSTRACT

Because of the hardware and software requirements, multimedia projects can be very expensive. This paper will discuss how I developed my first multimedia project on a very small budget. More specifically, I will discuss the hardware and software available to do a multimedia project and how to focus one's choice on the best use of the PC platform available. I will also discuss the project development and implementation. Lastly, I will show the finished multimedia product.

MULTIMEDIA

What is multimedia? Multimedia is the use of text, graphics, pictures, animation, sound, and video in presentations (3). To make multimedia even better, many add interaction, which means involving the user when he/she runs the multimedia application. This type of multimedia is called interactive multimedia.

Multimedia is very important today and is now used all around us. One key area of multimedia use, especially interactive multimedia, is education because it helps both the teacher and student . It allows the teacher to become more of a facilitator (taking the teacher out from behind the lectern) in the classroom. Multimedia also allows the teacher to have more time to interact with the student, focusing more on each student's specific concerns and helping him/her to learn. In addition, multimedia gives each student the opportunity to learn at his/her own pace by providing a way for the student to review material anytime and by giving the eager student the opportunity to even look ahead.

Before anyone can develop multimedia applications, one must have the appropriate hardware/software platform. A typical multimedia hardware and software platform is shown below (1,2):

I. HARDWARE

Insight Multimedia Computer

{SYMBOL 183 \f "Symbol" \s 10 \h} 486/DX2-66mhz
{SYMBOL 183 \f "Symbol" \s 10 \h} 8MB memory
{SYMBOL 183 \f "Symbol" \s 10 \h} 245 MB hard drive
{SYMBOL 183 \f "Symbol" \s 10 \h} 15 inch NEC MultiSync 4FG monitor
{SYMBOL 183 \f "Symbol" \s 10 \h} Talon TA-200 CD-ROM drove
{SYMBOL 183 \f "Symbol" \s 10 \h} Pro Audio Spectrum 16 sound board
{SYMBOL 183 \f "Symbol" \s 10 \h} Labtec speakers

or

Dell Multimedia Computer

{SYMBOL 183 \f "Symbol" \s 10 \h} 486/SX-33mhz
{SYMBOL 183 \f "Symbol" \s 10 \h} 4MB memory
{SYMBOL 183 \f "Symbol" \s 10 \h} 170 MB hard drive
{SYMBOL 183 \f "Symbol" \s 10 \h} 14 inch super-VGA monitor
{SYMBOL 183 \f "Symbol" \s 10 \h} Panasonic CD-ROM drove
{SYMBOL 183 \f "Symbol" \s 10 \h} Sound Blaster16 sound card
{SYMBOL 183 \f "Symbol" \s 10 \h} Labtec speakers

II. SOFTWARE

{SYMBOL 183 \f "Symbol" \s 10 \h} Asymetrix Multimedia Toolbook

The multimedia functions supported by this hardware/software platform are as follows:

{SYMBOL 183 \f "Symbol"} Text
{SYMBOL 183 \f "Symbol"} Graphics
{SYMBOL 183 \f "Symbol"} Pictures
{SYMBOL 183 \f "Symbol"} Animation
{SYMBOL 183 \f "Symbol"} Sound
{SYMBOL 183 \f "Symbol"} Video

However, the key factor in getting started in the area of multimedia development is the cost of the hardware/software needed. If one looks at the cost of the platform just described, it can be broken down as follows:

I. HARDWARE

INSIGHT Multimedia Computer	$3,999.00
or	
DELL Multimedia Computer	$2,349.00

II. SOFTWARE

Asymetrix Multimedia Toolbook	$700.00

TOTAL (Based on 1993 prices)

HIGH	$4,699.00
LOW	$3,049.00

These costs seems high especially with many educational institutions currently facing major budget cuts. Since many university departments may not have the funds to undertake such a project, it may be necessary to look for other means of funding such as grants from state or federal sources. Alumni organizations as well as outside companies are other possible funding sources. However, the securing of funds for such a project takes time. This is time we do not have because we want to start developing multimedia projects as soon as possible. Multimedia projects, however, can be started with a very small budget without any outside money.

MY FIRST MULTIMEDIA PROJECT

My first multimedia project is entitled the MF CICS Multimedia Project. The goal of this project is to develop a help system for the students in a CICS class. More specifically it is being developed to give the student a way to learn the features of the MFCICS software without having a copy of software.

My first thought on building this product came in the early summer 1992 when I saw a need for a tutorial for the MFCICS product since there was none available. Next, after teaching the CICS class for the first time during the Fall 1992, I saw firsthand the real need and urgency for having this tutorial. It was during the Fall 1992 teaching of the CICS class that I recognized the problem my students were having in the class. Because students didn't have access to the labs, they were having difficulty learning all the necessary features of the MFCICS software quickly so they can move forward in the class; therefore, class became less productive because I spent much time reviewing material rather than moving ahead.

This project is being developed using the following software: MF COBOL Workbench with the MFCICS option (for screen captures), and Asymetrix Toolbook (development software). This project is also being done with the help of the following Computer Technology students: Jonathan Bradshaw, Bradley Douglass and Ryan Emily. These students have previously taken the CICS class during the Fall 1992 semester.

The following hardware and software was used in this project::

I. Hardware: IBM PS/2 Model 70 (386 20mhz)
   {SYMBOL 183 \f "Symbol"} 120 Meg hard drive
   {SYMBOL 183 \f "Symbol"} 6 Meg of memory
   {SYMBOL 183 \f "Symbol"} 1 3.5 HD diskette drive
II. Software: Micro Focus COBOL Workbench
   {SYMBOL 183 \f "Symbol" \s 12 \h} Micro Focus CICS option
   {SYMBOL 183 \f "Symbol" \s 12 \h} Windows 3.1
   {SYMBOL 183 \f "Symbol" \s 12 \h} Asymetrix Toolbook 1.5

The actual cost for this project to my department is $000.00. This is because I owned both the hardware platform and software. Even if one does not already own the software, the Asymetrix Toolbook software can be purchased for approximately $300.00 with an educational discount. The only other requirement for a similar multimedia project is a standard 386 or 486 personal computer which would more than likely be available in one's department.

While there were other hardware options available that could have been used in the project. such as sound cards, video cards, and a CD-ROM drive, none were chosen because of my department's low budget. Also, my project did not need of any of these additional multimedia features.

The Asymetrix Toolbook software was chosen for the following reasons:

{SYMBOL 183 \f "Symbol" \s 12 \h} Popularity = in multimedia development
{SYMBOL 183 \f "Symbol" \s 12 \h} Availability = my having a copy in my home office
{SYMBOL 183 \f "Symbol" \s 12 \h} Familiarity = my having training in this software
{SYMBOL 183 \f "Symbol" \s 12 \h} Use ability = supports all multimedia functions thus allowing for growth

As to the status of the project, it is now about 90+% complete. It will be completed sometime late this summer and used for the first time in a class during the Fall 1993 semester. I am looking for great success from this project. However, I do expect some changes to occur based on the experiences gained during the first time it is used in class.

YOUR FIRST MULTIMEDIA PROJECT

As to your first multimedia project, you should first decide on a project and what you want to accomplish in your project. You should then determine what multimedia functions you need to use in your project, then re-evaluate these functions based on the software and hardware available to you. Do you need text, graphics, pictures, animation, sound, and video for your project? What multimedia software do you have available? What will your current hardware support? What will be the future of the project? Can it be expanded to use some of the additional multimedia functions if the hardware/software becomes available?

For my project, I chose the multimedia functions supported by my current hardware and software. Because hardware was my greatest limiting factor, I had to decide what multimedia functions I could use based on my hardware platform. Note, my first and foremost concern for my project was to meet the project goals and I was able to meet these goals even with my hardware constraints. As to the future of the project, I already had ideas as to where I can go when additional hardware resources became available.

CONCLUSION

Multimedia development can be very expensive based on the hardware and software requirements. However, when building one's first multimedia project, one does not have to use all the bells and whistles available. Consideration of the actual needs of the project and the budget limitations should be one's fist priority. One can still accomplish a multimedia project on with limited resources and a small budget. One must also consider the future direction of multimedia development she will be taking.

As one can see from my multimedia project, I was able to accomplish my key project goals with very limited resources. As to the future, my project still provides an opportunity for growth by allowing me to move into sound and video as the funds become available. When this occurs, I don't have to start over, I can enhance the already exciting project.

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MEETING THE CHALLENGE: CREATING MULTIMEDIA TO TEACH CRITICAL THINKING SKILLS

Sharon B. Colton

ABSTRACT

The process as described will take the audience through the instructional development team formation, materials gathering, script writing and casting, video production, laservideo disc pressing, computer software choice and authoring, e-mail and listserv set-up for student collaboration. The final product uses critical thinking skills in the nursing care of an AIDS patient.

INTRODUCTION

The School of Nursing at the University of Louisville, as a requirement to their yearly accreditation process, was required to teach critical thinking skills to nursing students. During this time Information Technology was offering incentive grants to create and use technology in instruction. Two nursing faculty members were appointed by the Dean of the School of Nursing to work with me as a representative from Information Technology to determing the feasibility of the project and write the grant proposal as appropriate. Both nursing faculty members were new to this area of technology, neither owned a computer, although they had some experience with electronic mail and Word Perfect at work. Both wre highly skilled in the nursing profession having many years of experience but had not taught critical thinking skills as a specific component of coursework. The grant of $10,000 of equipment and services was awarded in the spring of 1992. The goal was to have the project completed and used in the classroom during the fall term of 1993.

GRANT

Nursing students need excellent critical thinking skills because graduate nurses make difficult decisions which require them to apply a broad base of knowledge under difficult situations. It is imperative that students learn the processes of independent thinking, clarification of thoughts, listening and communicating accurately, and they must learn how to be responsible for identifying basic ideas, principles and meanings of the clinical situations they encounter. They must be able to analyze, synthesize and implement creative nursing solutions to the patient care situations.

The problems in teaching these skills to students lies in the little opportunity for consistent patient observations and the ethical issues of allowing nurses to work through sometimes incorrect patient care decisions using a real patient.

The solution as proposed was to use technology to provide a simulated consistent patient observation, the opportunity to make and try out patient care decisions without harming a patient, and a forum for the discussion of the decision making process.

The grant proposal as written requested the following:

funds for participation in a conference on critical thinking,
20% release time for the two faculty members to develop the learning module,
10% salary for each faculty with matching funds provided by Nursing,
videotaping (in-kind from U of Louisville @ $1,000)
laservideo disc pressing ($1500),
purchase of software ($100),
instructional design and project coordination (in-kind from U of L @ $1,000),
loaned equipment for presentation.

The Faculty/IT grant selection committee chose to fund all but the conference expenses.

PROCESS

The team consisted of Dean Justine Speer as administrator, Patricia Lacefield, M.S.N., Ed.D. and Ruth Voignier, M.A., M.S., R.N.as faculty instructional content developers, Ken High, Randy Cissell and Ron Harrison as the video production team, and Sharon Colton, M.Ed. as instructional designer and project coordinator.

The two nursing faculty attended a conference on the teaching of critical thinking skills in nursing education in order to familarize themselves with the latest thinking and practice in this area. Research in this area generally shows little correlation between the teaching in the classroom and the measured learning of critical thinking skills. The challange was to create an instructional process which involved the students in a hands-on, meaningful, carefully orchestrated learning experience which required the use and practice of the specific identified critical thinking skills. A consistent (and repeatable) patient observation for all students is critical to this instruction.

The instructional tpic first selected was that of a pregnant teenager on drugs but that was changed when the need for greater familiarization in the care of an AIDS patient became timerly. Working one day a week for five months, a script was written for the eventual videotaping which was annotated to identify critical thinking skills as they were addressed. A parallel script was written to be used for computer information and questions. Others helped in this process. The Gay Activist Coordinator advised on gay issues and culture. The university committee for gender/race/religious bias made suggestions concerning appropriateness. The drama club of a local high school practiced the script, made suggestions from an acting point of view and volunteered to perform for a group in order to test the script. The observers included specialists in content, nursing practices, video production, instructional methods and development as well as student nurses. All were asked for written evaluations and the entire process was taped as well for evaluation purposes. During the next month the script was re-written.

A cast was selected using people with acting experience whenever possible. The local gay community provided two experienced actors for the gay parts. Although we were originally to use a patient with AIDS, we later decided against this for humanitarian reasons. Makeup was used to make our patient/actor look ill.

Editing took another month. The 3/4" videotape we used was edited specifically for the pressing of the laservideo disc. These specifications include color bars, blank frames and a time limit of 30 minutes total. Once the laserdisc is pressed one cannot go back and correct errors in editing or taping.

The original plan was to use LinkWay software due to the available hardware limitations of 640k double floppy 8086 computers. A decision was made by Nursing to purchase an 8MB RAM 386sx VGA computer and to use Asymetrix ToolBook for software authoring. This software supports better resolution and includes more advanced authoring functions to better meet our requirements. Programming of this instructional module is still in process although at some time we will need to consider it final. It includes instructional looping to allow a student to try out one course of action and then try another.

We are in the process of writing an instructional manual and setting up the student e-mail. We will also set up a "listserv" to allow students and faculty to interact and discuss as a group decisions and practices, thereby reinforcing the learning needed to develop critical thinking skills. This course will be implemented as a pilot project in the fall of 1993. Once this pilot is evaluated, research data has been compiled, and suggested changes made to the instructional program, copies will be made available to other nursing schools which will broaden the discussion made possible by the listserv open to the world-wide internet.

SUMMARY

A detailed description of the technology will be handed out during the presentation. The discussion will include problems encountered and how they were solved as well as the dynamics of the team process needed to complete a project of this complexity. Yes, it was well worth the time and effort. If anyone would like the results of the research, please contact Sharon Colton as listed below or the University of Louisville School of Nursing.

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MULTIMEDIA: A NEW VISION FOR THE CLASSROOM

Patricia A. Bergeron

ABSTRACT

Multimedia will play a major role in school restructuring by the year 2000. The genesis of this restructuring process is currently observable. Teachers and students are utilizing the resources of electronic databases and multiple media in the 90's. Students come to school with multidimensional interests. We must provide them with rich environments that foster success.

INTRODUCTION

Multimedia will play a major role in the restructuring of schools by the year 2000. Multimedia (the combining of text,still images, motion video and high quality sound controlled by a computer) has the greatest potential to empower the student and stimulate learning. Its interactive environment enables students to pursue ideas, synthesize knowledge and solve problems. Evidence of this restructuring process is already observable. Teachers and students are utilizing the resources of telecommunications, electronic databases and multiple media in the 90's.

We can no longer view schools as one-dimensional institutions. Students come into our classrooms with multidimensional interests and abilities. They are comfortable with technology and view it as a resource. Multimedia has the potential to address students at their level of operation and via their learning modalities. It works for any style of learning, breaks down language barriers and is appropriate for any level of expertise. We need to view students holistically and employ an interdisciplinary approach.

IMPACT

Collaborative learning thrives in the resource-rich multimedia environment. The sharing of information from many and diverse resources is facilitated in the multimedia setting. The team approach is being emphasized more often in U.S. business and industry. We are learning from other nations that collaboration is critical. Students will gain from experiences in their education that promote a collaborative approach.

The graphics resources of video, video disks, CD-ROM, and TV enliven a multimedia classroom and improve student performance. It engages the student. Imagine studying mammals of the world via CD-ROM by choosing graphics, text and sound to bring up information such as maps, timelines and databases. A picture really is worth a thousand words. Research states that we remember 20 percent of what we hear, 40 percent of what we see and hear and 75 percent of what we see, hear and do.

LEARNING THEORY

Higher order cognitive processes and challenges to learning are at the core of L. S. Vygotsky and Jean Piaget's learning theories. Piaget proposed that the nature of interaction is best served by making available a rich environment that will include challenges and cognitive conflict. Vygotsky wrote about using the tools of the society. He stated that the thought is as important as the behavior. The interaction provides activities that pose cognitive query and encourage inner dialogue. He asserted that the main function of the interaction was to model and güide thinking about subjects, activities and the world. The multimedia environment provides this thought-provoking structure. Problems in learning could be corrected in this setting where interactions are activity centered, tool related and thought oriented.

We need to redefine the meaning of education in the context of the Information Age. We cannot lose sight of the principle that pedagogy ranks above technology in the restructuring process. If we look at computing and instruction we cannot help but see it in the light of sound pedagogical approaches. Multimedia pushes us to examine how learning takes place and to explore theories of cognition. This is one of the most thought provoking and potentially regenerative events to occur in education in recent years.

INNOVATION

Multimedia technology challenges the traditional hierarchical structure of schools and the Industrial Age model. This tradition is steeped in the use of textbooks and lectures and views teachers as the givers of all knowledge.

This model is not practical, relevant, interactive or effective. Multimedia takes the burden off the teacher to possess all the knowledge. A wide range of information is at the fingertips of both student and teacher. Review is easy as is acceleration to another level of discovery; consequently motivation stays high and mastery is ensured.

The Information Age has arrived and we have not changed our vision. Multimedia provides the opportunity to redesign our educational model of uniformity. Individualization of instruction is fostered. The highly interactive nature of multimedia, with objectives clearly stated, provides a rich opportunity, for students to be actively in charge of their learning. For example, in a chemistry class students could manipulate chemicals to create an explosion. They would experience the reaction of the chemicals but this experiment would be economical, safe and interactive. Learning in this new way is dynamic and fun and achievement is greatly improved. A 1990 Department of Defense study states that achievement was improved by 50 percent when students used computer-based, interactive video over conventional instruction.

We need to provide students with opportunities to be researchers and lifelong learners. Multimedia provides the environment for students to be creators of their knowledge. They can be the authors of the curriculum. Student assessment is easily accomplished with multimedia, which effectively measures reasoning skills, problem solving strategies and the synthesizing of information. Keeping student portfolios on a computer in the context of a multimedia environment is efficient and timely. Multimedia databases of the student performance are easily edited and can follow them throughout their years in school.

In the multimedia environment the teacher can access all types of databases with a point and click of a mouse. Via a network gateway, information can be accessed and shared from multiple CD-ROM Jukeboxes in a library/media center. Resources are easily shared and students are in charge of their learning. They can link ideas and thoughts together in a nonlinear environment. This is the natural way we think.

A recent Department of Labor report states that students will need certain skills to thrive in the 21st century. They will succeed if they can take responsibility, work cooperatively and collaborate. They especially need to be able to cope with change. Learning how to learn, to model and figure things out will be invaluable in the 21st century. Multimedia develops critical thinking skills and supports Socratic learning. As William James stated, "Genius means little more than the faculty of perceiving in an unhabitual way." Multimedia provides a vehicle to look at education in a different way.

SUMMARY

Computer technology has influenced education tremendously in the last ten years with the advent of the PC in the classroom; multimedia's rich environment will have an even greater effect on what happens in the classroom and out. Multimedia provides the tools of interaction that best promote learning. Students are highly motivated and in control of their learning. They have at their fingertips information that empowers them to choose invitations to knowledge that are multi-sensory and meet them at their level of operation. This rich contextual environment, based on the theories of L. S. Vygotsky and Jean Piaget, provides models of inquiry and challenges to thought. Students develop critical thinking skills and reach a higher level of cognition. The multimedia environment provides them with involvements that question and lead to internalization.

In our rapidly changing society it is important that students gain skills in how to learn and work cooperatively. Telecommunications and Distance Learning connect and link us today in one global community. Interdependence is a reality and computer technology aids us in our web of communications. We must reach out and connect our ideas and our visions to address the issues of the Global Community. The fertile environment of multimedia will aid in the process of school restructuring. It is rich with metacognitive opportunities that are easily observable. Learning strategies and critical thinking skills are stimulated. New ideas are unleashed using the tools of our society. This new vision can lead us to a renaissance and rebirth in education. The following quote by Emily Bronte is timely in our examination of education and multimedia. "I've drempt in my life dreams that have stayed with me ever after, and changed my ideas; they'd gone through and through me, like wine through water and altered the colour of my mind." Multimedia has the potency to transform the color of education.

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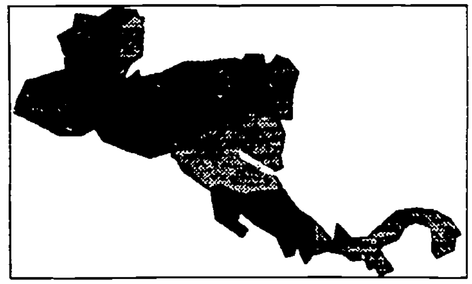
MULTIMEDIA IN A THIRD WORLD NATION--PANAMA

Carlos F. Lam, Beryl Martinson, and Victor A. Barragan

Technology is concentrated in the United States and other industrialized countries, such as Germany and Japan. it is no surprise that third-world countries lack development in the area of facilities and information networking, particularly in the public sector. This presentation focuses on the situation in Panama. While Panama has certain historical and logistical considerations that set it apart from most of the other less-developed countries, much that we present can also be extended to other countries in Central America and undoubtedly to other countries in of the developing world.

Figure 1. Map of Central America

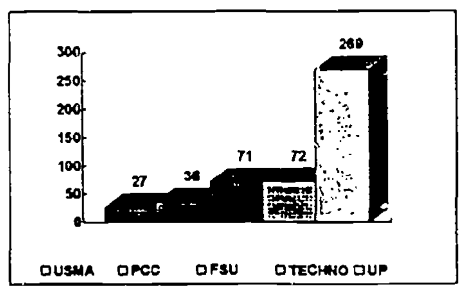


Panama links Central and North America with South America and is divided by the Panama Canal. It has historically been closely tied to the United State; its currency is the U.S. dollar, and much of its politics have been and probably still are controlled directly and indirectly by the United States administration and military. There are also many cultural links: much intermarriage and educational input from the United States and from the U.S. Canal Zone system.

With a 2.5 million population, Panama is not overly crowded by Latin American standards, but it is growing rapidly. The population is bottom heavy - with the largest and fastest growing part of the population being the children.

There is a great diversity in education between the public and private schools. This is a change from 25 years ago when the best schools were the public schools. Today, the public schools are characterized, as one might expect, by limited facilities, large classes, poor teacher training, virtually no technology, and low paid teachers who often work two or more jobs. Private schools range in excellence, but the better ones fully prepare students for later studies in the private universities or abroad.

Figure 2. Students per Computers at Panamanian Universities



There are five major universities and six smaller ones, including a naval academy. Even in the best of these, there are no new library technological advances such as CD-ROM. So, education is sound for those who can afford it, but technology, particularly in the computer area and library facilities are lacking.

In order to improve the multimedia situation in Panama, of course, the key is financial investment. However, there also must be progressive thinking in terms of organization, training of personnel, and outreach into the interior of the country. In addition, educators must be encouraged to expand their networking with information bases - both in terms of systems and in terms of human resources - so that they have the latest output on techniques and research.

Multimedia has great potential for growth in Latin America. From 1986 to 1990, computer exports from the United States to Latin America grew every year except in 1987. The sales potential for American firms is still great in the Latin American market and calls for more computers are on the horizon as individuals and businesses discover the advantages of computers. With this increase in demand will come requests for multimedia programs with which to store data, give presentations, and aid in education.

In Panama alone, more than $19.5 million of computers andperipherals entered the country in 1992; this translates into roughly 18,535 computer systems, and demand for computer systems is still growing. Because of its close ties with the United States, the Panamanian multimedia market will expand before the markets of other Latin American nations. Currently, only private individuals and companies can really afford multimedia, which presently comes in the form of CD-ROMs and SoundBlaster cards; these multimedia systems are primarily used as encyclopedias and means of entertainment. As more firms learn about the advantages of multimedia, they will consider it an essential tool in keeping up with the changes in business; they will be eager to purchase this technology in order to get ahead of the competition.

At present, hardware and software are scarce and high-priced. For a multimedia market to flourish in Latin America, less-expensive (because of economic difficulties), sturdy (because of the lack of ideal working conditions), and uncomplex (because of a lack of education) hardware must be developed and marketed. Software translations to Spanish and Portuguese are fundamental. A way to combine new media is of paramount importance; some institutions have outdated equipment that can provide a powerful tool if connected with up-to-date technology.

All educated people realize the interdependency of the nations and people in the world. No country is so rich that it can afford to neglect the less privileged. On the other hand, no country is so poor or underdeveloped that its intellectual leaders cannot strive for improvement and for education. The networks are there and they are growing. As information crosses cultural, political, and language borders, linguistic considerations must be taken into account. Librarians, in particular, whose profession immerses them in information and whose training prepares them for organizing and disseminating information, must carry the torch for putting information into forms that are concise, complete, and clear.

Developed countries and less-developed countries may have differing priorities, but we should all have one common overriding goal: to make the world society healthier, both physically and spiritually. We are all amazed at the continuing advances in technologies, but the most amazing accomplishment of all will be world access to information and education. We who are privileged to be leaders have the responsibility to work toward this goal.

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MULTIMEDIA FOR SPEAKER SUPPORT: ISSUES IN DESIGN, PROGRAMMING, SYNCHRONIZATION AND MEDIA INTEGRATION

Jon Gorrono and Ken Weiss

ABSTRACT

Very little research has been done on the application of multimedia to speaker support in a live presentation environment. The presenters recently completed a large multimedia project in support of a keynote address to CAUSE (an association of information technology professionals in education). The development, presentation, and subsequent analysis of this presentation highlighted a number of critical areas in which multimedia for speaker support differs from more common applications of multimedia. In this presentation, we will "reverse engineer" the CAUSE keynote presentation and discuss the issues that arose in design, programming, synchronization, timing and media integration, and the solutions to those problems.

OUTLINE

1. Background

1.1. Definition of Terms

1.1.1. Multimedia - An integrated presentation including at least three of the following elements in a synchronized computer-mediated environment: audio, full-motion video, photography, still computer graphics, computer animation, text, hypertext.

1.1.2. Speaker support - Material intended for presentation to an audience by a speaker, and not for interactive use by an individual.

1.1.3. Interactivity - The ability to control the sequence of display elements in a multimedia presentation in a non-linear fashion. While linear control is interactivity at some level, in the context of this presentation we will only consider multimedia to be interactive if more than one possible sequence of elements exists.

1.2. Description of our project - A 50-minute multimedia presentation used to support the Associate Vice Chancellor for Information Technology of UC Davis in delivering the keynote address to the December, 1992 national meeting of CAUSE (an association of information technology professionals in education). The presentation includes still computer images, full motion video, audio, photography and computer animation. The development environment was based on the Macintosh Quadra 950. Macromind Director was the primary software used for control and integration. Video came from a laserdisc player. A wide variety of support software and equipment was used to develop elements of the presentation, including a TOPAS 3D animation system, Adobe Photoshop, Super 3D animation software, Aldus Freehand, and a full video editing suite.

1.3. The production process - Description of the workflow for the production, estimation of time spent and expenses incurred, roadblocks and snags, suggestions for improvement.

2. Special considerations for Multimedia speaker support

2.1. User interface - must be extremely simple. The situation is analogous to display and control systems for air-traffic controllers. The speaker is typically not well-versed in technology, and is under considerable stress. A complex user interface is doomed to fail under these conditions.

2.2. Interactivity - should be minimal. Speakers are trying to persuade or inform their audience. A linear presentation of material provides the speaker with the most control over the situation. A linear presentation also places the least stress on the speaker.

2.3. Presenter skills and knowledge - will vary widely, so assume a very low level of technological skill and knowledge, and add more interesting (but risky) stuff only if the speaker can tolerate it.

2.4. Bomb-proffing - It is totally unacceptable for a speaker to cope with a software error in front of an audience of 1,400 people. A tremendous portion of programming and development time must be dedicated to bomb-proofing the presentation. This includes idiot-proofing as well (i.e., trap and discard all mouse clicks except when appropriate).

2.5. Portability - Live presentations are seldom given in the computer lab where they were developed. Considerable thought and planning must be given to making it possible to move the entire presentation to a new location and a new set of hardware without encountering errors.

2.6. Readability - The demands for screen design for speaker support are totally different from interactive single-user multimedia. Typically, speaker support programs are projected onto large screens in auditoriums. It is critical to plan for the inevitable degradation of the image quality, and design screens that will hold up and remain readable under these conditions.

2.7. Use of audio channels - Audio must not overwhelm the speaker. Once the speaker becomes a passive viewer of the multimedia material, instead of an active presenter of the material, the audience is lost. The speaker is one of the audio channels, and all other channels must be timed, synchronized, and levels adjusted to avoid conflicting with the speaker's voice.

2.8. Timing, Synchronization - These issues are particularly sticky in speaker support, because very few speakers are capable of hitting their cues and adjusting their pace precisely and perfectly to match a pre-timed multimedia segment. The speaker must have some means of adjusting the timing and synchronization on the fly, and the means of adjustment must be very simple.

2.9. Media Integration - Analog/Digital integration and conversion

2.10. Use of color, motion, sound to promote audience retention

3. Presentation of selected parts of the project, with commentary.

4. Evaluation of the effectiveness of multimedia as speaker support.

5. Conclusions & future directions, "What Would We Do Differently Today?"

MULTIMEDIA USER INTERFACE DESIGN FOR COMPUTER-BASED TRAINING

J. Morgan Morris, G. Scott Owen, and Marty D. Fraser

INTRODUCTION

Multimedia systems represent the synthesis of several longstanding technologies, including computers, video, print, and audio. In recent years multimedia technologies have become available at the personal computer level. These technologies should prove to be a powerful tool in many areas, including learning, persuasion, documentation, and visualization (Bunzel and Morris, 1992). Trends towards small, sophisticated, and powerful computers, represented today by notebook computers and personal communicators, will open the market for these technologies to larger segments of the general population.

The quality of a multimedia system depends on the integration of technology, information, and people. The goal of this paper is to present a set of recommendations for the design of an instructional multimedia system based on the literature and experiences in the design and implementation of such systems (Owen, Morris, and Fraser, 1992). The following design process is presented in more detail in Morris, Owen, and Fraser (1993).

MULTIMEDIA USER INTERFACE DESIGN

The following process describes he crucial steps in designing for usability as applied to he use of multimedia technologies. It consists of components selected from a number of sources, including Shneiderman (1992), Spencer (1985), and Whiteside, Bennett, and Holtzblatt (1988), then tuned to the needs of multimedia design.

INITIAL ANALYSIS

The Initial Analysis phase of user interface design involves collecting all of the information that may influence design decisions. The makeup of the user audience, the tasks they will perform, and the hardware and software they will use all affect the way that the system should be shaped to fit the users' needs.

AUDIENCE DESCRIPTION

One of the primary axioms of user interface design is to "know the user." This is necessary in order to plan the interface design to accommodate the user's needs and to evaluate the resulting design using representative subjects.

People can differ in many other ways; such differences have been studied in fields such as psychology and sociology. Many of these differences can affect the interaction between a human being and a computer system (Egan, 1988). For example, aging can change many interaction characteristics (Czaja, 1988; Morris, 1993). A user's individual aptitudes and abilities may influence the degree to which the use of visual technologies are beneficial. Spatial abilities have been linked to several areas of computation (Gomez, Egan, and Bowers, 1986), and it may be the case that those with below average spatial abilities benefit most from an animation. Blake (1977) found that subjects with low spatial aptitude benefited from motion sequences more than those with high spatial abilities. A system featuring visual displays of information would certainly benefit those with below average reading abilities.

The technical, educational, and domain-specific background of the user population must be considered. Many concepts taught in school or in educational computer systems assume certain knowledge and abilities that are necessary to grasp the new concepts. In the domain of computer programming, searching and sorting algorithms are important for programming any realistic system, and these core concepts are often taught early in the curriculum. A multimedia instructional system for teaching these algorithms could feature textual descriptions and animations of the algorithms to allow students to view the process described by static code. Understanding many of these algorithms requires basic knowledge. For example, in order to understand the heap sort, a student must first be familiar with the concept of a binary tree. This also means that the student must have previous background in programming in order to understand the use of sorting routines.

Given the diversity of characteristics of computer users, software designers must be made aware of the differences so that they can construct the interface to fit the user population. The steps to take in developing an audience description include the following:

1. Determine which characteristics are needed
2. Collect data from existing sources
3. Collect the remaining data

Once the set of characteristics has been identified, existing sources are surveyed for compiled data. When characteristics are needed but unknown, the designers must either make an assumption about the characteristics, or use interviews and surveys to gather the needed data. There are numerous sources of survey and questionnaire construction guidelines, e.g. Berdie et al. (1986) and Labaw (1980).

When collecting data for external environments, knowledge of the following characteristics is often important for the success of the instructional system:

- **Reading Abilities and Habits.** Instructional systems will continue to depend on text to impart many forms of knowledge. It is important to identify the range of reading levels so that text can be written at the appropriate readability level. If the audiences has common reading habits, i.e. they read some of the same magazines, newspapers, or other materials, then the text can be tailored to a familiar style.
- **Education.** The type and level of education can influence the wording and design of the system. For example, those with technically oriented educations will generally have a background more compatible with understanding computer technologies. If the audience is from a liberal arts background, then the computer technologies should be transparent to the user.
- **Computer and Technical Background.** Devices and concepts that are familiar to developers, e.g. mice and windows, may be completely new to many users. Special training sessions may be necessary before beginning instruction.
- **Familiar Computer Software.** Users may be accustomed to certain user interfaces; if so, the new system should be as consistent as possible with the familiar systems. If not, the differences should be emphasized during initial training.
- **Age.** Many skills and abilities vary with age. If a wide age range is noted, then the system must be flexible enough to allow users to continue using the system as their abilities change.
- **Visual, Auditory, and Physical Impairments.** All impairments should be anticipated. For example, synthesized speech could cause problems for some with hearing impairments, since most synthesized speech is distorted. Any action communicated in one modality should be duplicated in another in case of impairment. For example, screens should be designed assuming monochrome to ensure that color coding does not hinder those with color deficiencies.
- **Attitudes.** Attitudes toward using a computer-based instructional system can influence its success. Attitudes toward existing documentation can often carry over to the electronic system.

The final outcome of the audience description should be a set of characteristics, data corresponding to these characteristics, and an analysis of the data. The analysis should describe the implications of the data on the proposed system design.

TASK PROFILE

The second basic tenet of user interface design is to know the user's tasks. The user performs tasks within an environment, and this environment shapes the functionality of the system. An instructional system may be designed as a "standalone" system, i.e. the material is complete and there is no "teacher" or "class." In contrast, the system may be designed to augment a teacher's lessons. Each context poses a unique set of problems for the system designers. For example, a standalone system must provide more detailed guidance for the user, while a lecture-augmentation system generally must provide more flexibility for change. Thus, the beginning of the task profile may be to provide a statement of purpose for the proposed system that makes mention of the interaction context. It may also mention several interaction scenarios, i.e. contexts featuring specific user segments and their interaction needs.

Next, the full range of functionality should be identified. One starting point is to arrange all of the system actions and system objects into tabular form. This action/object table will typically have the actions labeling the rows and the objects labeling the columns. A check is placed in each cell where the action/object is permissable.

In order to design from the user's perspective, the action/object table must be reorganized to reflect the user's goals. Once identified, the actions and objects can be structured by arranging them hierarchically. The task profile is a high-level description of the tasks that the user will perform while using the system, from the user's perspective. Many of the tasks can be stated as a hierarchical combination of action/object pairs, such as the following example from a word processing environment:

- edit document
  --insert paragraph
  --delete paragraph
  --insert word
  --delete word, etc.

At this level of design, the syntactic details of the actions, e.g. keystrokes and mouse movements, should be omitted, concentrating only on the semantic level. This semantic ordering of tasks should reflect the user's goals in using the system. For example, a user's top-level goal in revising a document is "edit document," even though there is no such command in the system. Approaching the task profile from the user's perspective will be benefic when developing the detailed task analysis in the Detailed Analysis Phase. It is important that the profile be a exhaustive one, as this profile will directly affect the features and functionality of the proposed system.

Frequent tasks in using instructional multimedia systems include browsing or reading, and searching for particular pieces of information. In order to browse a particular article, chapter, or section, a user must get into the system, then navigate to the correct location using the system's user interface.

- Browse article <A>
  --Enter the system
  --Navigate to article <A>
  --Process article <A>
  --Exit the system

Exploring the information chunk may involve reading from text, examining a diagram, watching a video, or listening to audio.

- Process article <A>
  --Read text <A.text>
  --Examine diagram <A.diagram1>
  --View Video <A.video1>
  --Listen to Audio <A.audio1>, etc.

Searching is a feature of electronic systems not found in printed materials. Most authoring systems provide some sort of search facilities so that keywords can be located quickly. String searching, history mechanisms and indices are all useful tools when searching. Consider an example where a user wants to search for the string "task analysis," then read the article that contains it.

- Search for string <task analysis>
  --Enter the system
  --Use system's search facilities to search for <task analysis> until found
  --Process article
  --Exit the system

A feature-analysis list is useful for comparing existing designs and in identifying the tasks to be included in the profile. Many popular computer magazines use feature lists to compare products. For example, one (Fersko-Weiss, 1991) lists the features of several popular hypertext/hypermedia systems including Guide, Hyperties, SmarText, and several others. Such summaries are useful in avoiding the needless repetition of collecting and comparing information.

If there are data available concerning the frequency of use of the functions in related software or in previous versions of the current software, then those data should be presented in the Task Frequency Analysis. If possible, the frequency of use should be broken down into a table composed of audience segments and their associated use frequencies.

Once tasks have been identified from the user's perspective, appropriate metaphors may be identified to encapsulate the cognitive requirements of the task domain. Metaphors provide electronic counterparts for familiar objects. For example, the desktop metaphor is used extensively in many personal computer user interfaces, and it affects the objects presented to the user and the way in which they interact to accomplish the functionality of the system.

Appropriate metaphors for many instructional hypermedia systems include the notebook, the encyclopedia, and the classroom. Many authoring systems come equipped with graphical backgrounds appropriate for a particular metaphor. One of the frequent graphical backgrounds in several authoring systems is a notebook. This analysis should present all potential metaphors and their corresponding matches and mismatches (Carroll, Mack, and Kellogg, 1988).

DEVELOPMENT PLATFORM ANALYSIS

The system will be developed using particular hardware devices and software products. Many software tools are necessary to develop sophisticated features of an interface such as graphics, video, etc. All hardware devices and software tools should be identified. Often, new devices or tools must be acquired to meet the needs of the design. These should be identified and costs assigned to each acquisition.

INTERACTION PLATFORM ANALYSIS

The user often interacts with different devices and software tools than does the developer. The user's platform should be identified, and differences noted that may result in oversights by designers. For example, development platforms are often state of the art and extremely fast, while those platforms produced as products may be less sophisticated in order to reduce costs.

If particular software products form the basis of the proposed interface, then any usability data corresponding to that software should be identified. The feature analysis lists can be a good source of information for comparison of features of existing hypermedia products. Usability assessments using particular authoring systems also are good sources of information, such as Nielsen and Lyngbaek (1990) for Guide.

Additionally, usability considerations for hardware should be noted. For example, some situations may require a larger screen than usual. Some environments are better suited for a touchscreen, others for a mouse or keyboard. The usability characteristics of the interaction devices should be analyzed and described. Many of these characteristics can be found in the literature or in guidelines documents.

MEDIA ANALYSIS

Media forms including text, hypertext, static graphics, photographs, animations, video, speech, music, and sound may be used to communicate in multimedia user interfaces. Each media form should be used appropriately and to fit an intended purpose.

Text remains the most pervasive form of instructional media, due to the established use of printed materials. Other media can be used to augment or enhance textual passages. Descriptions can be enhanced by graphics or photographs when the referent can be represented visually. Static graphics and photographs can be used to indicate temporal sequences, but they can be presented most effectively with animation or video. Animations are useful for the above structures when the referent is abstract or otherwise impractical to video. For example, an animation can show the details of a building by lifting the roof off a building; filming such a scenario would be an unlikely and unwanted occurrence.

In some cases, the addition of graphics or other visual information may be superior to the exclusive use of text. For example, Kamman (1975) found that two flowchart formats were superior to printed instructions for comprehension accuracy and speed. Bauer and Eddy (1986) compared two representations for command language syntax. One used meta-characters (BNF) and the other used a flowchart-like representation. In all three experiments, the graphic method was superior in learning time and error rate. Booher (1975) compared several formats for comprehension of instructions: print, pictorial, pictorial-related print, print-related pictorial, pictorial-redundant print, and print-redundant pictorial. Of these, the pictorial-related print and the pictorial-redundant proved best for comprehension. These studies all indicate the need for careful, task-related integration of text and static graphics to enhance performance.

Speech, music and other sounds are useful in many situations. The use of speech to accompany a video of someone speaking, for example, is a common and expected use in multimedia systems. McConkie (1983) proposes that allowing the system to pronounce an unfamiliar word may cause users to read at higher levels. Music is useful as background for videos and other media elements, and as a media unto itself, e.g. in a music instruction system. Audiolization refers to the presentation of information by combinations of sound. For example, Brown and Hershberger (1991) use sound to convey information about algorithm animations, often using pitch-weighted values to indicate items involved in comparisons and switches. They list several uses of audio in a user interface:

- Audio reinforces visual cues
- Audio conveys patterns
- Audio replaces visual views
- Audio signals exceptional conditions

Blattner et al. (1991) provide an example of scientific audiolization for the representation of information concerning turbulence in fluids. Gaver (1989) describes a direct manipulation environment in which sounds indicate an object's size and type.

Hypertext is a medium available only on computers, although some features of other media have hypertext-like features. Rather than featuring a linear structure that typifies a text, a hypertext is organized into nodes and links, with the navigation through the information space under control by the user. The author of a hypertext must attend to the structuring of information and facilities for navigation within the system.

Documents frequently form the basis for hypermedia instructional systems. For example, a hypermedia system may be built from existing documents such as manuals, textbooks, and other printed materials. Other media forms, e.g. photographs and video clips, often are available for interface construction. Thus, at this phase, it is important to determine (1) how media will be used, (2) what exists, and (3) what must be prepared. Plans must be made

to develop needed media components and to ensure that appropriate hardware and software is available to facilitate the process.

DOCUMENTATION ANALYSIS

Users have needs for assistance when using a computer system. Frequent forms of such assistance include quick references, user manuals, and on-line assistance. This analysis should identify the appropriate forms of documentation to be included with the system.

Most multimedia systems should feature on-line assistance, since the capability exists to match the user's information needs with information presented in an ideal modality. Many uses for hypertext help have been cited (Campagnoni and Ehrlich, 1989), and multimedia help has been explored (Sukaviriya, 1991; Sukaviriya et al., 1992). For example, Sukaviriya (1992) states that traditional textual help provides little support for visualization of tasks, especially in systems with a strong visual component such as graphical user interfaces. A prototype was developed to explore the use of multimedia technology for on-line help. The system she described supports context-sensitive animated help by showing animated input devices operating on screen objects.

Other media forms may be used to support on-line assistance needs. For example, a video of a user using the system can enhance initial training by providing for learning by modeling.

DETAILED ANALYSIS

Once the initial data have been collected, a more detailed analysis can be conducted. the Detailed Analysis phase consists of several components:

- Usability Guidelines Analysis
- Usability Specification Analysis
- Detailed Task Analysis

Media form	Uses	Comments
Text	• Good for description, temporal sequences, explanation, compare-contrast, definition-examples, problem-solution • Necessary for abstract, nonvisual information • Good for labels, titles, captions	Main instructional media
Static Graphics	• Good for description, location/spatial information; can be used for temporal sequences (cycle charts); compare-contrast (histograms) • Good for depictions of objects, data organization, and visualization • Used for background for text, other displays	Includes diagrams, maps, tables, charts, graphs, etc.
Hypertext	• Useful when links, associations are important • Shneiderman's Three Golden Rules: (1) Large body of information organized into numerous "fragments" (2) The fragments relate to each other (3) The user needs only a small fraction of the fragments at any time	Computer media only
Animation	• Useful for simulating physical processes • Good for depicting "invisible" or impractical processes • Useful for temporal sequences • May be used as an attention mechanism or for entertainment	Not available in printed text
Still Photography	• Can show people, places, things • Can enhance descriptions, explanations •Can be used to illustrate temporal sequences or to provide examples	
Motion Video	• Powerful communication tool • Useful for documentary-style presentations • Useful for presenting different points of view • Can provide for learning by modeling	Not available in printed text
Music	• Good for background for displays, etc. • Can be used to indicate temporal changes • Potentially useful for scientific audiolization	Not available in printed text
Speech	• Useful for systems messages in some situations • Pronounciation of words can help low ability readers • Often accompanies video of people	Not available in printed text
Sounds	• Useful as attention mechanism	Not available in printed text

Table 1: Media Uses

USABILITY GUIDELINES ANALYSIS

Although a wealth of empirical data regarding human-computer interaction issues have been collected, not everyone is capable or even interested in wading through the literature to extract recommendations for design. To meet the need of the non-empirical user interface designer, numerous guidelines documents have been developed.

Additionally, many corporations wish to promote a common "look, touch, and feel for application interfaces. In these cases, corporate standards and guidelines are developed to enhance consistency and provide guidance in many design issues regarding menus, interaction devices, and many other screen design issues.

The first phase of developing the Usability Guidelines Analysis is to analyze existing guidelines to determine whether they are appropriate for the current design. Topics such as screen design, menu design, window design, and other typical user interface issues may also be relevant for a multimedia interface design. The analysis should result in a guidelines document that is readable and easily referenced. A consistent organization strategy should be used for the sections and subsections so that each entry may be assigned a unique number. There should be major sections pertaining to, but not limited to, areas common to all user interfaces such as screen design, menu design, error messages, etc. For hypermedia development efforts, there should also be sections pertaining to the following:

- navigation
- hypertext usability
- media

Each entry should be comprised of a brief title, the guideline, an example of its application, and a reference stating the source from which it was obtained.

Although general guidelines are available, e.g. Smith and Mosier (1986), most were written with interfaces other than multimedia instructional systems in mind. In fact, there are very few guidelines specifically intended for hypertext applications with diverse media. Specific guidelines for the development effort can be derived from the Interaction Platform Analysis and the Media Analysis. Navigational needs and hypertext usability guidelines can be based on the usability information contained in the Interaction Platform Analysis. The media guidelines can be based on the information gathered in the Media Analysis.

USABILITY SPECIFICATION ANALYSIS

"Ease of use" is a vague term. The purpose of the Usability Specification Report is to state in precise terms exactly what usability is for a given design. The attributes used to specify usability will be useful in evaluating the usability during iterative design, and in measuring how well the system meets the specifications upon release.

Usability attributes should be selected that are important for the current design. Common attributes in user interface design correspond to installability, initial use, learning rate, errors, user evaluations and attitudes, comparisons to other products, etc.

Whiteside, Bennett and Holtzblatt (1988) provide a technique for specifying attributes. There are several components associated with each usability attribute. For example, using the attribute of "installability:"

(1) Attribute:	installability
(2) Measuring Concept:	installation task
(3) Measuring Method:	time to install
(4) Worst Case:	one day with media
(5) Planned Level:	one hour without media
(6) Best Case:	10 minutes with media
(7) "Now" Level:	many can't install

The *Measuring Concept* and *Measuring Method* components describe what activity is performed as the attribute is measured, and the particular response variable to analyze. Given a particular response measure, thresholds should be set realistically that determine success or failure for each attribute. The *Worst Case* corresponds to the lowest acceptable level for the metric, i.e. a lower bound on "what counts as a success." The *Planned Level* represents a "success," and the *Best Case* should be an agreed-upon state of the art limit for the attribute. The *"Now"* Level corresponds to the present level of the attribute in current systems.

There is no definite technique involved in setting the thresholds. If a system already exists, the thresholds may be set according to its level. If a similar competitors' product exists, it may be used to determine the levels. Otherwise, the values must be estimated.

Some typical attributes that are relevant to a multimedia design include:

- Readability of text
- Initial subjective evaluation
- Long-term subjective evaluation
- Browsing efficiency (Ratio of nodes visited to total nodes)
- Retention of Information

- Directed search effectiveness
- Ease of navigation for first-time users
- Visual components evaluation

DETAILED TASK ANALYSIS

The Detailed Task Analysis should provide a detailed organization and identification of user goals and tasks down to the level of specific physical and cognitive operations. One well-known technique is that of GOMS (Card, Moran, and Newell, 1983). It is named for its components: Goals, Operators, Methods, and Selection Rules. The techniques for constructing a GOMS suitable for task analysis are left to Kieras (1988).

INITIAL DESIGN

Once all data have been collected and analyzed in the necessary detail, the system and user interface may be designed.

The Initial Design phase consists of several components:

- Visual Design Demonstration
- Media Production Plan
- Implementation and Evaluation Plan

VISUAL DESIGN DEMONSTRATION

While the detailed task analysis may provide a detailed and perhaps quantitative look at the design from the user's perspective, there is nothing in it that provides someone with a sense of the "look and feel" of the design. Multimedia systems usually have a strong visual component that is difficult to communicate verbally.

Several techniques exist for providing someone with the visual elements of the design. Common techniques include rapid prototyping and storyboard design.

With prototyping, a brief (perhaps nonfunctional) representation of the interface is prepared using either a basic form of the software system or some other software. This allows a viewer to see the design in true context, and can allow limited interaction with the system to provide feedback at the earliest design stage possible. Wilson and Rosenberg (1988) cite several advantages of rapid prototyping, including the ability to test questions that cannot be answered specifically by guidelines, and the provision of a common reference point for the designers. Disadvantages cited include the ability to ignore limitations and contraints that apply to the real product and the potential for creating unrealistic expectations with an oversold prototype. The use of rapid prototyping can speed development and reduce costs by condensing the transition from design to implementation. Multimedia platforms using existing authoring packages provide an excellent base for rapid prototyping, since skeletal outlines of the complete system can be provided, with some of the more important information components filled in.

Storyboards are useful when prototyping is not possible, and for augmenting incomplete components of the prototype. In this form, paper or cardboard representations of screen sequences are prepared with narratives to depict common use scenarios. Storyboards have been used extensively in the creation of video and animations, and may be used for the development of static and dynamic images, including screen representations in a user interface. Storyboards offer many of the advantages of prototyping in that they can present the visual sense of the system and allow designers to share a common reference point. The lack of an interactive dimension is a major disadvantage, since it precludes feedback from potential users.

Regardless of which technique is used, it should provide the viewer with a sense of "what is done" and "what it looks like" for common situations.

MEDIA PRODUCTION PLAN

Development of media components that are to be a part of the user interface are often developed using several hardware devices and software systems. For example, an animation may be developed on a workstation, stored in one file format, downloaded to a personal computer, then converted to a file format suitable for animations. All such loops should be identified, along with the nature of the media to be developed. Flowcharts are useful for identifying the major steps involved in production.

Once all production loops have been identified, storyboard designs for all visual elements and scripts for all vocal elements should be prepared, along with plans for any other media. Flowcharts are also useful for plotting the flow of action within a component of the system.

IMPLEMENTATION AND EVALUATION PLAN

The interface development effort should be broken down into meaningful chunks, with evaluation corresponding to the usability attributes mentioned in the Usability Specification Analysis taking place. A project time-line should be developed which includes all deadlines for development and evaluation.

Two useful techniques to meet this purpose include Gantt charts and PERT charts. A Gantt chart typically is labeled with time periods on the x-axis and project components on the y-axis. Horizontal bars are used to indicate the beginning and ending times for each component of the project, as well as the entire project. A PERT chart is a graph with nodes corresponding to states and arcs corresponding to activities. PERT charts are useful for showing all of the dependencies involved in a design effort, as well as identifying critical paths for completion of the project.

ITERATIVE DESIGN

A system designed for usability must take the user's needs into account. This process is begun in the Audience Description, and a system can be developed according to usability principles and guidelines without anyone ever using it. There are too many complexities and intricacies in any computer system to plan for them all, and it is necessary to allow representative users to provide feedback and to discover any problems.

Once a portion of the system has been developed, observational studies are useful for discovering problems and oversights. These studies need not be meticulous in design, but should feature users unfamiliar with the system. Once problems and oversights have been corrected, then a more rigorous approach is necessary.

The usability attributes developed in the Usability Specification Analysis should be tested when relevant, in accordance with the Implementation and Evaluation Plan. Representative subjects should be used to measure them. For example, questionnaires could be developed to measure a user's attitudes towards the system, and performance measures such as time to complete a task or percent task completion can be evaluated.

Given the measured attributes, should any fail to meet successful levels, the problems should be corrected and re-evaluated. Once all user feedback has been incorporated, another portion of the system can be developed, and tested. This process continues until all of the system has been developed and it successfully passes the established thresholds for the usability attributes.

FOLLOW-UP

Once implemented, there should be techniques for gathering data. An on-line monitor can capture interaction-level information, and a log can be kept of questions for the interface. If there is a technical support line, the calls can be tracked to determine where most of the problems lie. Surveys and questionnaires are useful for determining user attitudes once the system has been developed and used for a period of time.

This information is useful for developing new versions of the same system, and for developing similar systems.

CONCLUSION

Multimedia computing systems are expected to be used extensively in educational settings in the near future. The quality of these systems depends on the ability of the system to communicate with users effectively using diverse media. This effectiveness can be assured only with a systematic approach to design and evaluation and a design process that features user characteristics in the original design and the implementation.

Several projects have been developed at Georgia State University using this process. HyperSludge has evolved over time to become a multimedia tool suitable as a training and reference tool for employees of a wastewater treatment plant. It is our hope that future multimedia applications will focus on the ability of the system to communicate with the users rather than on the technological issues alone.

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STUDENT DEVELOPERS: LEARNING THROUGH CREATING MULTIMEDIA TERM PAPERS

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ABSTRACT

Multimedia in the classroom takes on new meaning when students use this exciting medium to create interactive multimedia "term papers". This overview will explore the strategies and methods used to guide the students through the research and development of comprehensive multimedia presentations on a variety of topics.

INTRODUCTION

If you think the personal computer made a significant impact on the way students write their traditional term papers, wait till you see what the introduction of multimedia will do! This new sensuous medium has the potential to revolutionize the academic research paper. Students will no longer be locked into dry, linear presentations of words, reference material and footnotes. Using multimedia technology they can create interactive presentations with hyper linked information, pop up footnotes, as well as audio and visual files that enhance their ability to communicate information on the required topic. Unlike traditional research papers, this new medium requires the students to use all of their senses, enabling them to discover new ideas and information through a variety of learning styles. The final product is as exciting and interesting for the student create as it is for the instructor to review.

TEACHING TOMORROW TODAY

As an instructor for the Commercial Graphics program at Trident Technical College, I have had the opportunity to teach two different courses in interactive multimedia and observe first hand how students learn through this new technology.

The first course, Multimedia Techniques, introduces the student to image editing, palettes (templates that define mode, color and text), audio capture and editing, digitizing and editing video images, simple animation, creating trigger fields, and authoring. Students learn all these techniques by completing a variety of exercises which are then combined into a simple interactive presentation. Once the basic skills have been mastered, the class begins a final project which requires them to produce a comprehensive presentation on an assigned topic. Through experience I have found that this task is best accomplished as a group project. I have the students break up into teams and research a specific aspect of the topic. Materials are gathered from print, video and audio sources. The teams then meet as a group to compile the information, develop a flowchart, write a script and design a storyboard. Once this has been accomplished, the following new teams are formed, each having responsibility over a specific area of production:

Graphics	Design screen templates to ensure consistency and create final screens with the requires trigger fields and video images
Audio	Record and digitize voice, music and sound effects
Video	Select and digitize video images
Animation	Create the necessary animated sequences
Authoring	Create interactive script

The team approach not only enables the students to complete the project in a shorter period of time but it gives them some experience on how a large project is accomplished in a production studio.

The second course, Multimedia Presentations, picks up where the first course ends. Students learn that effective interactive media requires careful up front evaluation and planning. After studying the overall process of developing a project, each student selects a topic and produces a complete planning document that includes:

1. clearly defined goal and target market
2. program methodology
3. research material from print, video and audio sources
4. flowchart, written script and storyboard cards
5. an evaluation instrument

Once the planning document has been presented to the class and approved by the instructor, the student moves into the production phase. This includes designing screen templates, creating screens and animation,

digitizing audio and video files, and authoring. The final product is a comprehensive, interactive multimedia presentation which includes footnotes and bibliography. Each student presentation is evaluated by the class for effectiveness, content, accuracy, creativity and ease of use.

CLOSING REMARKS

In the two and a half years that I have taught these courses I have observed the students as they become completely involved in their subject area. The computer lab becomes electric with excitement as they discover new ways to communication the ideas and concepts related to their topic. They not only gain multimedia skills and knowledge of their topic, they rediscover the joy of learning.

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SPECIFICATION OF A EUROPEAN PUBLIC MULTIMEDIA INFORMATION SERVICE

Martijn Hoogeveen and Jerker Andersson

ABSTRACT

Within the area of telecommunications, research is directed at the specification of a Public Multimedia Information Service (PMIS). Market research indicates that, potentially, there is substantial commercial interest in Europe. A PMIS is feasible with current and evolving technology. The viability on the short term of a PMIS is more uncertain. The most promising areas of application include entertainment, tele-marketing, tele-training and tele-publishing.

INTRODUCTION

Multimedia telecommunication is an international growth market (Systems Dynamics, 1993). Multimedia successors of Videotex are anticipated. Within the context of EURESCOM, a joint research centre of European public network operators, research is performed on the specification of a pan-European integrated multimedia service. This is a kind of multimedia value added network service (MVANS) or Public Multimedia Information Service (PMIS). In this paper we will use the latter term to avoid the non-discriminating term MVANS. We define a PMIS as an integrated whole of applications that perform multimedia information services by using public infrastructures. Multimedia is used in the sense of the ability of a system to combine multiple perception media, like text, music, speech, picture, video, et cetera. We see the PMIS as an electronic marketplace where customers meet service providers. The PMIS, using a public network as exchange medium, needs to be an easy vehicle for people to use. It should support making business deals, exchanging information, advertisement et cetera. By using evolving standards and technologies within the fields of, among others, intelligent networks, information coding, multimedia, this can be achieved.

Both PTT Research and Infologics are involved in EURESCOM research, and perform private multimedia research related to public information services (see also Van der Linden & Duursma, 1992). In this article the position of PTT Research and Infologics regarding PMIS is elaborated. PTT Research is the research laboratory of Royal PTT Netherlands (KPN), which is in a process of privatisation and which is the owner of PTT Telecom (Dutch Telecom). Infologics is a subsidiary of Televerket (Swedish Telecom).

FEASIBILITY OF A PMIS

Experiments in our laboratory on a PMIS using N-ISDN (Narrowband-Integrated Services Digital Network) (Van der Linden & Duursma, 1992) made clear that it is feasible to set-up such a service. Without using compression techniques basic rate N-ISDN (2B+D=144 kbit/s) is clearly insufficient for real multimedia retrieval. Primary rate N-ISDN (30B+D), however, offers about 2 Mbit/s throughput, which is enough for MPEG1 (Moving Pictures Expert Group) compressed video. MPEG1 delivers a data rate of up to 1,5 Mbit/s compressed video, well within the bandwidth of a primary rate N-ISDN connection. Also the elements of a multimedia retrieval service like a multimedia database with its management system, a multimedia user interface and the specific applications are feasible with current technology.

At the moment basic rate N-ISDN is in its process of introduction in Europe and commercial examples of N-ISDN services using Quadratel of Cap Gemini Sogeti, are at hand. Most of them, however, do not include video and audio, but only still pictures. Moreover, they are not embedded in an integrated service nor are they accessible publicly.

Although using compression techniques for video and audio (MPEG1) and stills (JPEG) may reduce the necessary bandwidth for a PMIS to about 1.5 Mbit/s, such a bit rate in principle still requires more than basic rate N-ISDN. High-speed modems (using ADSL and HDSL techniques) for transmission over copper may temporarily circumvent the problem, but the quality of video will lag behind. A new infrastructure in the access network (at home) may be needed to switch to primary rate N-ISDN. MPEG2 and MPEG3, for high quality video purposes, will need even more bandwidth than MPEG1. In this case only the use of satellite connections or cable networks in the case of interactive television may be considered as serious possibilities. B-ISDN (Broadband-ISDN) with a variable bandwidth of up to 150

Mbit/s is not commercially available within 10 years and is dependent on fibre-to-the-home. In Japan NTT has already decided to invest in fibre-to-the-home, but this is not the case in many other countries. Thus, in the short term B-ISDN can not be considered to be the basis of a PMIS, anyway.
In conclusion it can be remarked that a solution including N-ISDN, MPEG1 and JPEG (Joint Photographers Expert Group) compression and high-speed modem techniques may be the basis for a PMIS infrastructure. MPEG1 offers reasonable video quality. It seems to be worthwhile to experiment with such a solution.

VIABILITY OF A PMIS

The discussion above made clear that technology is not the real bottleneck in realising a PMIS with reasonable video quality. The feasibility of a service is only a precondition for its viability. The viability of a PMIS depends on the presence or expected presence of a multimedia public information infrastructure, the commercial interest and the service costs for users. Also legal issues like the copyright of video material should be dealt with.

The availability of a multimedia information infrastructure is a current bottleneck for the introduction of a PMIS. Requirements to any public information infrastructure are, according to Dertouzos (1991) that it is accessible to anybody, that it is easy to use, and that it is the basis for innumerable sensible activities. A multimedia public information infrastructure meeting these requirements is not yet available. Standardisation on N-ISDN, MPEG1 and JPEG, and a high speed modulation technique may serve as a short term solution.

Commercial interest

The commercial interest to invest in PMIS applications and the willingness to invest in PMIS connections are highly related. If there are enough connections, any company wants to use this marketing medium. At the other hand, if there are many interesting PMIS applications, the willingness to invest in PMIS connections will rise as well. A pragmatical way to resolve such a chicken-and-egg problem is the set-up of commercial pilots. Another way, used in the case of Minitel in France, is the free distribution of terminals or needed PC equipment. The latter possibility is only reasonable in a monopolist situation, not if free competition is involved as will soon be the case in Europe.

For what types of applications there is commercial interest? At the moment some categories of multimedia applications are subject of considerable investments. These are:

- Marketing & sales applications, for example in the form of kiosks presenting the products of a firm (Josephson, 1991);
- Training, for example in the form of Hypermedia Assisted Instruction (HAI) (Heller, 1990);
- Entertainment, for example in the form of a CD-I with Sesame Street or a CD-ROM with the Grolier encyclopaedia.

It can be foreseen that the commercial drive for especially marketing & sales applications and entertainment titles qualify these types of multimedia applications to first enter the realm of tele-multimedia. By embedding such applications in a PMIS the reach of such applications will grow tremendously. It may foster the development of a multimedia information market, at which people can work together (Computer Supported Co-operative Work), do their business and have fun at home. People and companies are interested in the use of applications for efficient purchasing of necessary products and services, for training on the job and at home, and just for entertainment.

A drawback for the production of multimedia applications is the copyright issue, especially regarding video. It should be univocal for developers how to pay for reasonable copyrights. There is also the problem of layered copyrights: a film producer may have the copyrights for the video content data, but a software firm may have the copyrights for the interactive application containing the video content data. A known problem of course is the protection against free copying of software. This problem should be dealt with, but is outside the scope of this article.

Outlook on cost developments

The costs of a PMIS are, like the public information infrastructure, a major bottleneck. When we take a horizon of ten years, things become different. Due to the liberalisation of the European telecommunication markets, the fixed and variable costs of a N-ISDN connection will soon drop to the cost level of a current telephony connection. This is also the case for the prices of multimedia equipment like Multimedia PC's, and MPEG1 and JPEG codecs (coder/decoder). The dropping costs of hardware and connections will

foster the acceptance of PMIS on the market. At this moment, for example, it is advised not to invest in PC's with a processor older than the Intel 486. Such a PC can easily serve as a multimedia terminal for an on-line interactive multimedia service. If a future PMIS terminal, including ISDN card, codec and high-speed modem, can be assembled cheaply from standard components, say for less than $500, the price will not be the bottleneck for acceptance on the consumer market. For the business market a high-end terminal may be devised, still at neglectable cost.

The variable costs of a PMIS depend on the duration of a PMIS connection, but also largely depend on the costs of the use of an individual application. The costs should be reasonable and the prices of information, products and services offered should be competitive. Production costs of information delivered by marketable services will form a major part of any PMIS investment. As the number of users grows the turn-around time shortens. This requires, however, that the market reaches a critical mass of consumers and providers.

Another aspect of the variable costs are the costs of telecommunication. With the possible introduction of ATM as communication protocol for B-ISDN variable bandwidth transmission becomes possible. This means that only the bandwidth is used that is really necessary. The use of variable bandwidth is an improvement over the use of a fixed 2 Mbit/s primary rate N-ISDN connection.

SET-UP OF A PMIS

As is the case with monomedia VANSs, like Videotex, five types of parties are involved: the users, the service providers, the information providers, the network providers and financial parties, like banks and credit card organisations.

The users of the tele-applications within a PMIS, need to be able to consume information or order for information, services and goods, and to pay for it transparently.

The service provider, probably an organisation like a Videotex organisation, keeps the PMIS in the air and is an intermediary between the users, information providers, network providers and financial parties involved. The service provider is the broker on the multimedia tele-market. The service provider may develop the applications for information providers, but information providers may do it themselves or put out that job to subcontractors. The service provider also offers the necessary PMIS connections, cards for a PC or PMIS terminals.

Information providers are the suppliers on the multimedia tele-market. They may be a chain of superstores offering a tele-shopping application, a travel agency offering its trips, a library lending its works of literature and art, or a museum with a tele-exposition of its collections.

The network operators have clearly the role of a facilitator. Their role is operating and maintaining the multimedia network, and pass on network costs.

The financial parties are involved whenever financial transactions are required beyond the regular service billing such as paying for the ordered goods, services and information.

A PMIS has a general information architecture, which only roughly corresponds with the Videotex architecture and architecture of modern PC's.

The first visible layer is formed by the service operating system. The service operating system may be visualised as a Windows client-server environment that encompasses all the general functions, like a graphical user interface, the accounting and billing functions, the use of private directories and menus for the set-up and selection of applications. The second layer is the application layer, which consists of information and the mechanisms to view and manipulate that information. Within the limits given by a style guide information providers are free to tailor their applications as they wish. For the application development a special provision is necessary: a tele-application development toolkit. For high-quality audio-visual applications a specialised production environment including expensive audio and video equipment is necessary for the recording, digitisation, editing, and encoding of content data.

The service operating system shields users and application developers from the third and lowest layer, the hardware layer, including computers, networks and their respective operating systems and protocols. In an ideal situation the service operating system is hardware independent and offers interfaces to different types of networks and computers.

For a PMIS it is necessary to distribute the applications. A distributed architecture helps to offer the needed processing power, but also to optimise the use of the network: applications used only in a certain area should be located on a server in that area. It is a matter of subsidiarity.

SPECULATIONS ABOUT THE NETWORK IN RELATION TO A PMIS

The network can be seen as just a vehicle for transporting PMIS data, and nothing more. If the PMIS should be set-up network independent this is ideal. Nevertheless, alternatives can be foreseen. To gain speed, accessibility and flexibility standard PMIS functionality can be integrated in the network. Examples of this include indices of information providers (Yellow Pages), service billing, databases with the network location of information providers (home registers), and service subscription information. More useful support functions could be mentioned and more will be discovered as the PMIS service evolves. We will elaborate on a few of these possibilities.

To make information about information easily available we would like to have on-line "phone-books" that connect us to an information provider of our choice by a simple mouse-click. This can be provided, as it is in today's Videotex services, by an external firm with a machine connected to the network. But it can also be supported by the distributed home registers and directories that support the future public network plans. This latter solution would improve access speed and the quality of such information. We also envision network intelligence to be used to support information distribution. Imagine a popular PMIS application located on several service access points. The network may lead the user automatically to the nearest service access point that is currently available. Server failures and congestions could be transparently dealt with by using a network location database containing information about such distributed facilities.

Another possibility is that the network deals with the protection of the identity of the user, if he wants to be anonymous and only wants to pay costs by the phone bill. In other situations the network notifies the user that the information provider requires user identification and offers the user the possibility to abstain from revealing his identity. In a third scenario we can imagine the information provider to refuse bad customers or the subscriber to the PMIS to limit the access capabilities of members of his household or employees of his firm. All such confidential information can be handled by the network, operating under applicable legislation to protect all interests.

CONCLUSION

A PMIS is only viable in the short term if a narrowband solution with codecs and high-speed modulation is accepted. An on-line PMIS service using primary rate N-ISDN is feasible but too expensive now. When B-ISDN becomes commercial available, probably in the first decade of the next century, this would be a better vehicle, but then fibre-to-the-home will be a basic requirement.

Another major problem is to convince users and information providers that a PMIS is in their best interest. Regarding the viability of a PMIS some bottlenecks are mentioned. Major bottlenecks are the expected fixed and variable costs of a PMIS connection and the absence of a ready-to-use multimedia information infrastructure. An initial effort of determined service providers is necessary to reach a critical mass and contribute to a true electronic marketplace.

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"TEACHING PHYSICAL SKILLS USING DVI AND DATAGLOVE TECHNOLOGY"

Janet Hazard

Design and production of textiles, require physical skills that are specific to the field. Interactive multimedia provides clarity, completeness and repeatability of demonstrations that are necessary to learn these skills. When teaching physical skills using interactive multimedia, the missing component is expert observation and feedback. To learn a technique properly requires practice that if goes unmonitored will result in the development of "bad habits," and further impedes the progress of learning.

This instructors interactive multimedia computer program demonstrates a solution for the problem of teaching physical skills with a 15:1 student teacher ratio. This ratio greatly reduces the opportunity for expert observation and feedback. The interactive program developed simulates the instructor in every way currently possible with the state of technology. Videotapes were produced that demonstrate each of the intricate physical skills. Each technique was recorded under optimum conditions, exceeding that of the normal studio situations. Special lenses and lighting captured the intricate details of each technique. The videotape was then digitized with the ActionMedia II card and stored on a 660 meg. Hard drive. Audio instructions captured are played back to the student when they run the video clip. Audio and video clips can be run independently of each other affording the student the option to just watch or just listen. The program is currently networked and available to student 24 hours a day. Students may use it in the textile studio where the knitting machines and computers are available side-by-side. The students use the program and practice the skills until they master the techniques.

During a semester the students learn a variety of computer programs used to design knitted fabrics and download them into knitting machines to be knitted. The interactive program allows the student to access the programs without leaving the interactive program's environment. The development of this program began with a careful evaluation of the course information and requirements. A detailed flow chart was constructed that included each aspect of the course. The flow chart became the template used to layout the screens in the interactive computer program. A fourth level language was used to activate the actions within the interactive program. Each part of the program is accessible as a book in that one can go to any portion of the book at any time. Navigation through the program is done by clicking on buttons found on the screen (with a mouse). There is a "map" page that acts as a road map through the program. From that screen the student can go anywhere in the program.

The program continues to be evaluated by students of Instructional Design at Syracuse University. Preliminary observations point to the need for more extensive interaction between the student and the program when a physical skill is involved. The skills are too complex to be self-evaluated by the learner. The computer is unable to "see" the student therefore appropriate feedback is not given. Many of the movements of the physical skills are negligible making them very difficult to teach even in a one-on-one situation. A solution was chosen by the instructor using DataGlove technology. DataGloves provide a method for recording and analyzing movements of the learner while the interactive program can retrieve and present the appropriate feedback. DataGloves are equipment from the research area of Virtual Reality (VR). The student can wear the DataGloves and practice a technique. When an error is made, the computer will respond by providing feedback prepared by the instructor in the form of digitized video and/or audio clips.

At this time the software that interfaces with the DataGloves is developed for the UNIX and Macintosh platforms. More and simpler authoring tools are available for the Macintosh platform than UNIX. There are many new developments in video capture and playback on the Macintosh that provide new possibilities. Because of these and other considerations the instructor has chosen to develop an interactive program on the Macintosh platform that is similar to the one currently on the IBM. At the time I prepared this document the C code interface was partially developed. At the AAIM conference in Savannah, Georgia on July 29-31,1993, I plan to present current developments of both the IBM and the Macintosh systems.

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THE EDUCATIONAL EFFECTS OF THE CLASSROOM PRESENTATION OPTION

Duane Moser, Laurel Halloran, Janet Burke, and Josephine Hamer

ABSTRACT

Four studies assessing the value of the Classroom Presentation Option (CPO) are presented. The CPO is a system of classroom keypads designed to promote interaction with students and feedback to the instructor. Each study uses control groups and is in a distinctly different field of study: accounting, nursing, education, and math.

BACKGROUND AND LITERATURE REVIEW

The use of modern technology has helped to improve many facets of our society. More accurate work can be done in much less time. We can be more productive than ever. Our educational system, however, has not kept pace. According to Mecklenburger (1984), we are a generation behind other segments of our society in the use of educational technology. In 1990-91, schools will spend approximately thirty-five dollars per student on all information-age technology. In most cases, this reflects only one-percent of their budgets (Mecklenburger, 1984).

The traditional methods of instruction are no longer suffi-ciently effective. Schools must use technology if they are to become more productive. Mecklenburger (1984) believes that when educators and students effectively use technology, the normal expectations of what school can be are exceeded. "Unique powers of modern life and communications technologies allow us to create educational systems that produce remarkable results" (Mecklenburger, 1984, p. 22).

Administrators and teachers often do not utilize technological developments to their advantage. Lack of interest, poor training and limited equipment contribute to this problem (Mecklenburger, 1984). The effective use of computers in educational settings therefore, remains just beyond our reach. "The read / listen / test / grade method of schooling is behind the curve while, regrettably, the electronic school remains at the head of the curve, but outside the grasp of most students" (Mecklenburger, 1984, p. 23).

If our nation is to be competitive with the rest of the world, we need to use the latest technology in teaching our children. "How well we incorporate technology into the education of our children will ultimately determine how competitive we remain in the global, technologically driven economy" (Brooks and Perl, 1990 p. 86).

Mecklenburger (1984) believes that if teachers can individualize instruction to a greater degree and if they can interact with students on a more personal basis, then graduates will be better prepared and more readily employable.

One way of helping teachers free themselves for more individualized instruction is through the use of interactive video-disks (IVD). Debloois, Maki and Hall (1984) feel that IVD have captured the imagination of educators and entrepreneurs alike. The major function of an IVD system is to encourage interaction and individualization. Students using IVD systems take an active role in the learning process.

The use of an IVD system helps learners to retain more information. According to Urbanski (1988), "We retain 25% of what we hear, 45% of what we hear and see, and 70% of what we see, hear and do" (p 48).

In order for learning to occur, learners must be mentally active in the learning process (Whitrock, 1989). Technology which can enhance participation can help ensure high retention levels (Meyers, 1990). The use of an IVD system does not guarantee that students will learn more, but they will learn faster and retain information longer (Ebner, Manning, Brooks, Mahoney, Lippert & Balson, 1984).

By using an interactive videodisk system, there is a two-way communication between the learners and the system. Therefore, the students can affect the pace and level of the instruction. Another currently available technology designed to enhance student participation is the Classroom Presentation Option.

The Classroom Presentation Option (CPO) is a set of keypads, one at each student's seat, which the students use to respond to questions posed by the teacher. The CPO is part of a system from IBM to enhance educational experiences. Other names for similar devices include Wireless Response Pads (HyperGraphics Corporation) and Student Response Units (IBM).

The keypads allow students to respond to True/False, Yes/No, Multiple-Choice, and numerical questions. The questions and their responses are intended to provide students with feedback on their progress and to provide the instructor with an indicator of learning. Based upon the responses, the instructor can alter the direction of the lessons. The keypads are also useful in obtaining facts and opinions which would not be freely shared in open discussion. For examples, "Who is your favorite professor?", "Are you a racist?"

This paper reports on four studies conducted during the 1992-1993 academic year at The Western Connecticut State University in four disparate academic areas: accounting, nursing, education, and mathematics.

In addition to measuring differences in learning course content, a survey was administered to determine how the use of the computer technology affected student attitudes. The survey is included as the Appendix of this paper.

HYPOTHESIS

Theory and prior research into the educational use of computer technology indicate that the CPO may have a positive effect on student learning. Therefore, the test hypothesis is that student learning was positively affected by the use of computer technology (1-tailed test).

THE STUDIES

The nursing, education, and mathematics studies used undergraduate classes during the Fall 1992 semester as control groups. These were conducted without the use of computer technology. Traditional lecture methods were used. The experimental groups were classes in the same courses held in the Spring 1993 semester. These classes used computer technology such as multimedia presentations and CPO. Each experimental group was then compared to its control group to assess the affect of the computer technology.

The accounting study focused more directly on the CPO. Both the control and experimental groups met during the Spring 1993 semester. Both groups received the same presentations, using a variety of formats. Lectures, videotapes, electronic slides, and some multimedia presentations were used at various times. The control group used the keypads at only one meeting to see what they were. The experimental group alternated between using and not using the keypads.

SOME RESULTS

MATH

The math study compared student achievement between two semesters of Math 120, Elementary Statistics. The course is a common-core math course, open to any student who has shown proficiency in algebra, either through testing or a remedial course. It is a course typically taken by students in such majors as mathematics (as a free elective), nursing, biology, medical technology, psychology or business, although it is open to majors in any field. The same instructor, text, syllabus and tests were used during both semesters. The only differences were the use of Toolbook, a multimedia authoring software package, for classroom presentations during the Spring semester, as well as the use of keypads for interactive student response for the second half of the Spring semester.

There were originally 28 students during the Fall semester, and 29 during the Spring. Twelve students completed the course in the Fall, and 15 completed it in the Spring. This is not atypical of this course since it is not a required class for any major. Only the students who completed the entire course were used for the study.

The research hypothesis is that the use of computer enhanced instruction through Toolbook utilization for classroom presentation, and the use of CPO, enhance student learning and attitude. T-tests were performed for each of 2 exams separately, as well as for the final grade. No significant differences were found between the two groups. In fact, the experimental group performed slightly worse for the second test than the control group.

The attitude survey was administered to students at the end of the Spring semester. In all areas, the students attitudes were generally on the positive side. Instructor-related responses showed the most positive results (average 4.046), with keypad the least (average 3.183).

NURSING

The nursing study evaluated the impact of computer presentation and keypad questions on attitudes and achievement in a course on Medical/Surgical Nursing. This nonequivalent control group, post test only design utilized a convenience sample of junior year nursing students to test the following hypotheses:

(1) There will be a significant difference in student achievement as measured by exam grades between a group of junior year nursing students taught using the computer presentation and keypad questions method and a group of junior nursing students taught using conventional teaching methods and

(2) Student attitudes toward use of computer presentation and keypad questions will be positive.

The sample for this study consisted of two groups of junior year nursing students enrolled in a Baccalaureate Nursing Program. All students entering the junior year must complete the same set of requirements and supporting courses. In addition, they must achieve a grade point average of at least 2.5 on a 4.0 scale in order to advance to the junior year. The control group consisted of 14 students taking Nursing Process II taught in a conventional

teaching method (lecture, overheads, oral questioning). The experimental group of 14 students were taught the same material using a computer presentation method and integrated keypad questions. The groups did not differ significantly on the variables of age, gender, or related health care experience. Both groups were evaluated using the same three exams. Exam One was a fifty-question multiple choice exam which covered the topics of gastrointestinal system and reproductive system. Exam Two was a fifty-question multiple choice exam which covered the topics of circulatory system and alterations in mobility. Exam Three was a twenty-five question multiple choice exam which covered the topic of the endocrine system. Exam score means are detailed in Table 1.

Table 1

Mean Scores by Group and Exam

	Exam 1	Exam 2	Exam 3
Control	82.14	82.6	78.4
Experimental	76.7	80.1	83.4

A t-test for independent groups was performed to assess if there existed a significant difference between the control and experimental groups on the variable of achievement as measured by exam scores. This did not prove to be significant at the p=0.05 level. Achievement did not differ significantly in the two groups.

The attitudinal survey gave more optimistic results. Students expressed favorable attitudes toward the use of the computer presentation and keypad questions. In general, they felt that it made class more interesting and highly organized. The keypad questions assisted them in focusing on their areas of weakness. In the nursing class, keypad questions were used to assess preparation for class by beginning each class with four questions taken from the assigned readings. Although the student responses were not factored into the grade, students felt they were accountable for assigned readings and were therefore better prepared. Additional keypad questions were integrated into the lecture. Students felt this assisted them in continually assessing their level of understanding of the content presented. Students were strongly positive about the use of computer presentation and keypad questions.

Although no statistically significant difference was found in achievement between the groups, the experimental group did show a trend toward improved exam grades as the semester progressed. This may have occurred due to increased comfort and understanding of the method of presentation. This trend was not evident in the control group. Another possibility is the concept of "vampire video". This refers to the idea that the method of presentation was so exciting or absorbing that the message or content of the presentation was lost. As the students became more familiar or desensitized to the method of presentation, they were able to focus more on the content. The method of communication could then take an assistive role rather than a primary role in teaching the class.

In summary, computer presentation and keypad questions are at least as effective as conventional teaching methods in conveying content regarding Medical/Surgical Nursing. Students have strongly positive attitudes regarding their use in class. As students become more familiar with the method of instruction it is possible that achievement may also be positively impacted.

EDUCATION

The class used was a curriculum strategies course for elementary education students. The control group had 29 student teachers, while the experimental group had 31. All subjects had a grade point average of at least 2.7 on a 4.0 scale.

Examinations were written from the instructor's manual accompanying the course textbook. Both groups took the same examinations. A ScanTron test machine was used to grade the multiple-choice examinations to help reduce grading errors. There is low likelihood that examination content was passed between groups because they did not have contact with each other. While one group was in class, the other was off campus involved with student teaching at various elementary schools throughout Connecticut.

The preliminary results of the study in the education course do not support the hypothesis of a beneficial effect from computer technology. The statistics, while not significant, have the wrong sign.

ACCOUNTING

The accounting study focused more narrowly on the CPO. The course, Managerial Accounting, is mandatory for all undergraduates in the School of Business. Most undergraduate business curricula have a similar mandatory course. Enrollment is mainly sophomores and juniors, but a few freshmen and seniors typically enroll.

Both groups received the same instruction techniques on the same topics. The controlled factor was use or nonuse of CPO in the experimental group. To help keep the teaching techniques from differing between classes, lectures were illustrated primarily through the use of prepared computer presentations. Self-written presentations using the multimedia authoring package Toolbook, from Asymetrix Software, made up the bulk of these. Electronic transparencies from HyperGraphics were occasional used. Most of the presentations consisted of animated illustrations, graphics, demonstration problems, definitions, and charts. Videotapes from ABC News and Pacific Lutheran University supplemented the presentations. Short videotape segments, 5-15 minutes in length, highlighted the manufacturing processes which are central to the course. Longer videotapes featured other professors teaching a topic. For going over student questions, the chalkboard was the main tool.

The subjects of the statistical tests were students, not sections. For each student i in group j, the following statistic is calculated:

X(i,j) = S(i,j,Yes) - S(i,j,No)

where

S(i,j,Yes) indicates the student's score on examination questions covering topics covered when the CPO was in use by the experimental group, and

S(i,j,No) is the student's score on examination questions covering topics covered when the CPO was not in use by the experimental group.

If the CPO had a positive effect, we would expect to see Mean[X(Experimental)] > Mean[X(Control)]

As of this writing, the data are not yet available. Data analysis will be by the use of the Wilcoxon distribution-free signed rank test (Hollander & Wolfe, page 27).

To eliminate subjectivity in grading as a noise factor in the statistical analyses, only objective examination questions will be used for the statistical tests (e.g. multiple choice, true/false). Other types of questions were given, but these will not be part of the statistics.

Data from the attitudinal questionnaire was nearly the same between the two groups for most questions. Using the median response as representative of each group, the only items having medians differing by at least one point on the five-point scale were deemed significant. The questions having significant differences were questions 7, 13, 15-19, 21, 22, 24, and 26 (see Appendix for text of questions). In each case, the experimental group was more enthusiastic about the object of the question (i.e. the instructor, CPO, computers, and the course).

DESIGN LIMITATIONS

As in any experimental design, there are factors which cannot be controlled for entirely. Below are several such factors which could affect the results, along with their possible consequences. Where some degree of control is implemented, the nature of the controls is stated.

1. Classes generally do not end the semester with the same enrollment as they began. All four studies deleted from the analysis all students not having completed the course. This will introduce a survival bias of unknown sign and magnitude.

2. Because each experiment was conducted with only one instructor using a limited set of instructional techniques, the results may not be generalizable to other instructors and techniques. To alleviate this problem, the accounting study varied the instructional methods employed.

3. No student will be exposed to a given topic as both part of the control group and as part of the experimental group. For example, only the students in one class will have the combination of CPO usage and the topic of Ulcers. It is possible that an effect attributed to the CPO is actually an effect of the selection of topics. The effects of an interaction between CPO usage and topics are confounded with the main effects of the CPO. The inclusion of a large number of topics should help to alleviate this.

4. The observed test scores should be independent of one another. To the extent that one examination builds upon materials covered on prior examinations, this may not hold.

5. The students are all undergraduates at The Western Connecticut State University. We believe that WCSU students are fairly representative of a large proportion of college and university students in America. It is a small, state-supported university located in an ethnically and economically diverse community. It has a significant number of transfer students and older adults. WCSU's primary mission is quality teaching, but other academic pursuits are encouraged and rewarded.

6. Most of the students in a given study have the same or similar majors. For example, Managerial Accounting was chosen, in part, because it has about the widest representation of student majors of all accounting courses. Students in accounting, finance, marketing, management, and a few nonbusiness majors were included. The heavy representation of business majors may limit the generalizability of the accounting study's findings. This paper addresses this in presenting studies in four very different disciplines.

7. It was not possible to have both the control group and experimental group meet in the same classroom. It is possible that results were affected by the different meeting place.

CONCLUSION

The use of advanced computer technology in education is essential if we are to improve our troubled educational times. There are, however, impediments. According to Clark (1984), there are two major obstacles to the use of such technology in education: Cost and acceptance by instructors.

Debloois et al. (1984) cites these obstacles to implementation: 1. shrinking budgets and 2. retraining of classroom teachers is slow and difficult.

It is a popular belief that the educational system in our country is not capable of producing acceptable results and America's ability to compete with other nations is severely endangered (Brooks & Perl, 1990). Thirty years ago, a futuristic thinker by the name of Buckminster Fuller predicted that television and computers would one day come together and that this would be the solution to our educational problems (Brooks & Perl, 1990). He was at least partially correct. We believe that computer technology is the modern analog of television.

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APPENDIX

ATTITUDINAL QUESTIONS

Please indicate on the 1-to-5 scale your level of agreement with each statement.

1 = Strongly Agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly Disagree

Istructor Related:

1. The instructor used a variety of teaching/learning strategies.
   Agree Disagree
   Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

2. The instructor used instructional technology suitable to course content.
   Agree Disagree

Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

3. The instructor kept most of the students involved in the lesson the majority of the time.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

4. The instructor presented lessons in an orderly fashion.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

5. The instructor's objectives were clear.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

6. The instructor evaluated the progress of individual students.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

7. The instructor's questions displayed many cognitive levels.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

8. The instructor appeared to enjoy the course content.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

9. The instructor encouraged comments and questions from students.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

10. The instructor asked stimulating questions in class.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

11. Questions asked during class discussions by the instructor helped me understand the material better.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

12. The methods of instruction helped me understand the subject.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

13. Major points in the class were clearly emphasized.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

Keypad Related:

14. Use of computer keypads encouraged me to ask questions in class.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

15. Use of the keypads was an effective tool in helping determine my personal level of understanding.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

16. Use of the keypads made the class more interesting.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

17. Use of the keypads helped me stay involved with the classroom topic.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

18. Use of the keypads made me feel like I was constantly being evaluated.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

19. Use of the keypads detracted from the course.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

Computer Related:

20. Computer assisted instruction programs should be developed to simulate real-world decision-making contexts.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

21. Computer literacy should be a part of all academic programs.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

22. I find use of the computer-assisted learning to be intimidating.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

23. Use of the computer assisted my learning by pointing out my weak areas.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

24. Computerized presentations made class material more interesting.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

25. Use of the computer inhibited my ability to learn.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

26.Use of the computer detracted from the course.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

Class Related:

27. The time spent in class was worthwhile.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

28. I looked forward to attending class.
Agree Disagree
Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

29. Class meetings were boring.

Agree Disagree

Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

30.I spent more time preparing for this class than I did for my other courses.

Agree Disagree

Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

31. Questions asked during class discussions by other students helped me understand the material better.

Agree Disagree

Strongly - 1 ----- 2 ----- 3 ----- 4 ----- 5 - Strongly

TOTAL QUALITY INSTRUCTIONAL DESIGN: INTEGRATING INSTRUCTIONAL DESIGN AND TQM

S. James Corvey and Larry Legg

Total Quality Management (TQM) has burst onto tne higher education scene in the last three years. A growing body literature attests to the appeal that the concepts of continuous improvement and enhanced quality have to the higher education community.

The efforts to implement elements of TQM however have meet with varying success. (Seymor, 1991) In general the applications that have had the most immediate success are those centered around the management and business functions of colleges and universities. This is understandable when one considers that the TQM movement came about as a response by American business to the perceived assault by offshore interests and involved the restructuring of management and the refocusing of many traditional business functions.

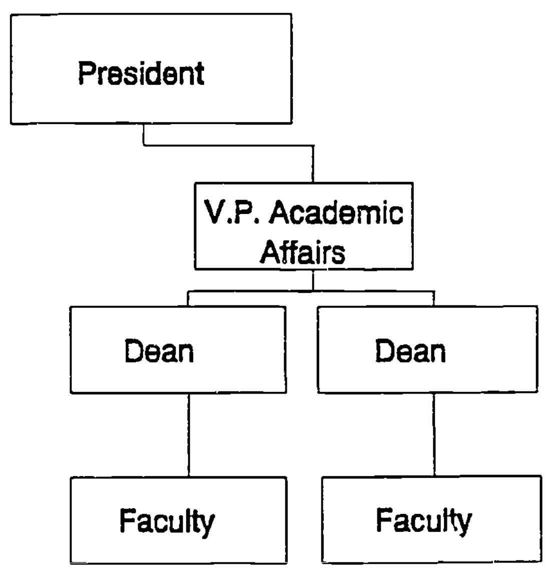
A second area that has received attention, though to a lesser extent, centers around the research and measurement of aspect of TQM. Much of the literature relating to measurement concerns itself with research on the process of implementing TQM. Less has been written comparing the outcomes of traditional processes to the outcomes developed as a product of Continuous Quality Improvement (CQI). Practically no institutional focus has centered on classroom research as an element of TQM.

Curriculum and instructional design and its relation to TQM, as broad areas of institutional interest, have received the least attention in the literature. This area has perhaps the greatest potential for the implementation of the concepts of CQI and the integration of research elements central to TQM.

This paper will bring together Curriculum and Instructional Design, Continuous Improvement, and Classroom Research to create a preliminary Continuous Instructional Improvement (CII) model.

To understand the uneven success in applying TQM principals to instructional design in higher education it is necessary to examine four issues that are influencing the adoption of quality initiatives. These four issues, Organization, Quality Improvement, Measurement and Design/Development Processes point to the divisions in structure, approach and attitudes that set educational institutions apart from the manufacturing and business. These differences are systemic, pervasive and central to the process of higher education in America.

When approaching the issue of institutional organization in higher education one is often presented with an organization chart reminiscent of those found in business. (figure 1)

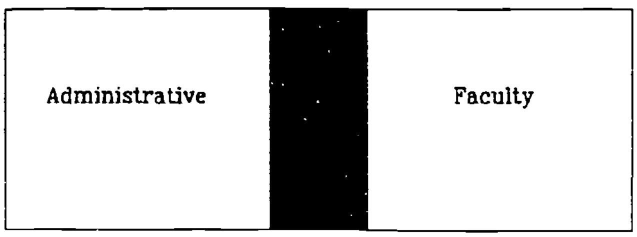


The model implied by this type of chart is hierarchical in nature and suggests a cohesive or at least relatively seamless line of authority and control from the President to the instructional Vice Presidents, Deans and Faculty. This model is at best incorrect and at worst has been responsible for fostering a false notion concerning the actual structure of institutions of higher education. There is in fact a dual authority system comprised of administration and faculty that exists in virtually all institutions of higher education. Winters (1991) discussion of the sometimes adversarial nature of that system identifies several differences in the relative role administration and faculty in the organization.

In general the administration through the hierarchical administrative structure provides for the basic needs of the institution. Administrative needs include the internal areas if business offices procedures, personnel procedures, physical plant operations and various hygiene factors as well as the external areas of finances, legislative relations, and alumni affairs. The role of administration in instruction is that of support for the educational processes and activities.

Faculty are primarily involved with internal influences involving instruction. In contrast to the hierarchical structure, faculty governance structures tend to be democratic in relation to the faculty role. In the university setting, research, tenure and issues of public service are in the arena of faculty governance.

Common concerns of administration and faculty can occur in any area identified; however, there is a clear interest on the part of both authority systems to foster Institutional Effectiveness, the Development of Staff, and continued Institutional Accreditation. (figure 2)



Issues of Organization

Administrative	Faculty
Deals with external influences *finance–legislative–alumni–community*	Deals with internal influences
Tends to be Hierarchical with Business Parallels *Business office–Physical plant–Personnel*	Tends to be democratic in primary areas *instruction–research–public service*
Supports educational process and activities	Carries out educational processes and activities
Planning	
Compensation and Benefits	

<u>Common Concerns</u>
Institutional Effectiveness–Development of staff
Instutional Accreditation–Compensation and benefits

The attempts to implement TQM in this dual governance structure have had predictably uneven results. On one hand many administrative processes and procedures have been shown to be positively effected by the application of the principles of TQM. On the other hand, there have been few reports of rapid successful implementation in the instructional area. One of the longest lived efforts in the implementation of TQM in the academic setting has been in place at Delaware County Community College since 1986. In a recent article chronicling the progress in the ground breaking institutional effort DeCosmo, Parker and Heverly (1991) state "The greatest difficulty may lie in adapting TQM to the teaching learning process, a phase DCCC is just beginning to enter." The question that arises is why implementation of a program devoted to quality should be difficult to implement in an institution that has at its heart a devotion to student quality and success.

Perhaps one answer can be found in recognizing the normal sequence of implementing TQM in an institution. In almost every case the initial phase includes enlisting "top management" in the TQM process. Top management in most cases has meant the management located at the top of the hierarchical organization chart. The model adopted from the Japanese calls for top management to lead the quality revolution. Juran (1989, p8) specifically identifies four successful steps the Japanese used:

1. The upper managers personally took charge of leading the revolution.
2. All levels and functions underwent training in managing for quality.
3. Quality improvement was undertaken at a continuing revolutionary pace.
4. The work force was enlisted in quality improvement through the QC-circle concept.

The belief that this initial first step must be taken with the top level administration of the college or university is reflected by Robert Chomesky (Chomesky, et al., 1992, p 95).

"The following five conditions for implementing TQM and TQI should be established sequentially, rather than at random:

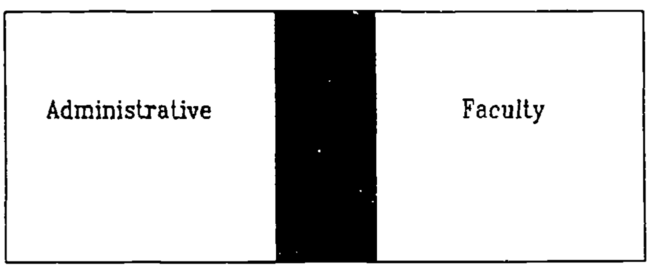
Condition One:Education and administrative commitment.
Condition Two: Education and commitment of faculty and staff.
Condition Three: Establish trust.
Condition Four: Establish pride in workmanship.
Condition Five: Change the institutional culture."

He further states:

> "Since implementing TQM and TQI requires an enormous deviation from how most managers supervise in universities and colleges, the president and her or his top managers should undergo a training program on the principles of TQM and TQI. Then, similar training must be provided to middle managers."

Implementation of TQM following this pattern has had success in the business world and considerable success in the administrative side of higher education. The approach however ignores the dual governance structure of higher education and the authority system inherent in the faculty governance structure. Because the implementation of TQM has in general found its initial thrust in training administrative personnel, the faculty have perceived the initiatives to be administrative in nature. In addition, by bypassing the top management in the faculty structure, the implementors of quality initiatives are effectively left out of the planning for TQM for the operational instructional elements of the institution.

One has only to identify the varying view of quality improvement between faculty and administration to begin to realize that the dual nature of governance has parallels in other perceptions and operations of institutions in higher education. (figure 3)



Issues of Quality Improvement

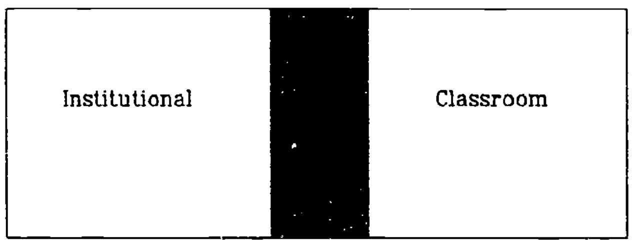
Administrative	Faculty
Focus on improved support *Business procedures-Personhnel-Student Recrutment-Employee Satisfaction* Measures of Overall institutional effectiveness	Focus on teaching *Development of materials-Improved communication with students-Improved classroom measurement-Student satisfaction*

<u>Common Concerns</u>

Critera for student success
Transfer-Placement-Satisfaction
Reward and recognition

The faculty focus on teaching is central to the mission of the institution. That is not to imply that the quality improvements fostered by the administrative authority are inconsequential or unnecessary. On the contrary, those issues are vital to the long term strength of the institution. It is that the issues of concern to administration are difficult to translate into the operational teaching occurring on a daily bases. The common concern for student success forms a bases for developing common quality measures that administration and faculty can both use as a benchmark. Patricia Cross points out that "...to date, TQM as applied in higher education has ignored the single most critical element in educational change-the faculty." (Cross, 1993) She concludes that although faculty have been ignored in the application of TQM thousands of faculty have embraced Classroom Assessment procedures as a means of determining whether and to what extent students meet the goals of classroom instruction. In examining the themes of TQM as they relate to the principles of Classroom Assessment she concludes that there is "remarkable congruence." The congruence Cross identifies relates to the principles of TQM as they relate to faculty assessment in the classroom and form only a portion of the total measures available.

Instructional measurement (figure 4) as seen from an institutional viewpoint reflects the same duality when related to classroom measurement that has been apparent in the organizational structure of institutions of higher education and stems from the same root. The institutional needs for measurement are macro in nature and with few exceptions have little application to classroom experience. Their importance should not be minimized because the measures form a general view of the success of the institutions academic programs and other procedures relating to the intake of new students and the follow-up of students exiting the institution. Many of these measures are required for state and national reports.



Issues of
Instructional Measurement

Institutional	Classroom
Student profiles	Standardized placement tests
Standardized tests *ACT-SAT-Others*	Departmental examinations
Incoming transfer records	Teacher evaluation
Overall GPA	Learning styles assessment
Student follow-up	Classroom research techniques

Common Concerns

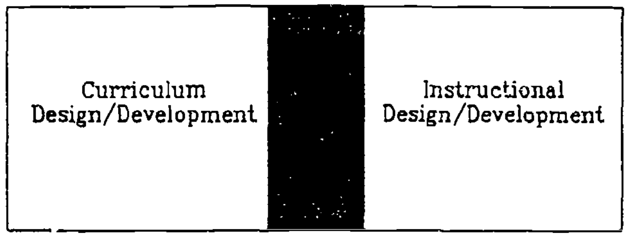
Student placement
Student success measures

Instructional measurement in the classroom is student based and reflects the progress of individual students involved in classroom activities. These activities are particularly suited to the types of measurement promoted by Dr. Edward Deming in his landmark book on Total Quality Management Out of Crisis. (Deming, 1982) The use of run charts, histograms and control charts as well as a few other techniques such as flow charts and fish bone charts form the bases for much of the statistical treatment used in TQM. (Walton, 1986) When coupled with the 50 classroom assessment techniques (CAT) identified in Classroom Assessment Techniques (Anglo and Cross, 1993) the classroom instructor has a powerful set of tools to implement TQM in the classroom.

In the first instance the institution is concerned with measures of the student body as a whole and in the second with the individual. The integration of the two thrusts in measurement may provide the institution with valuable insights into the relationship between institutional research and classroom research for quality improvement.

Research can provide insight into instructional problems and point toward methods to improve instruction in many areas. The thrust in TQM however is on managing variability and sorting outcomes into acceptable and unacceptable outcomes. Applied strictly the goal of TQM is to reduce variability by identification and removal of causes of variation. (Leek, 1993) Using definitions borrowed from TQM literature used in business occasionally leaves the educator with a vague feeling of unease. What does the removal of causes of variation mean? Should all students perform alike? Are students variables?

One way to place the research into context is to relate it to elements of instructional design. There have been many instructional design models proposed and implemented since the mid 60's. (Heinich, Molenda and Russell, 1989) Most of these draw heavily on Mager, Gagne, Bloom, Skinner and Maslow among others for the elements included in the instructional models presented. Most models draw a distinction between curriculum development and instructional development. (figure 5)



Issues of Design/Development

Curriculum Design/Development	Instructional Design/Development
Deals with results we want	Deals with results we get
Starts with what students must know	Starts with what students already know
Goal oriented	Process orientated
Institutional outcome driven	Student outcome driven
Control through planning and operational management decisions	Control through continuing information

<u>Common Concerns</u>

Quality
Student Success

Distinctions drawn between the two has a relation to the dual nature of many elements of institutions of higher education, although clearly both curriculum and instructional development are the provence of faculty. The duality is due to the difference between the goal orientation of curriculum development and the process orientation of instructional development. (Rhodes, 1992) Distance from day-to-day classroom operations removes curriculum processes from consideration by the classroom teacher when involved with developing instruction for students in an active learning environment. (Corvey, Miller, 1983) Instructional design, incorporating statistics from TQM and CAT, using the charting techniques of TQM as tools and the standard design elements found in standard models of instructional design however has the potential for providing the framework to implement a model of Continuous Instructional Improvement (CII) in higher education.

The elements necessary for integrating TQM in an institution of higher education are clear. They are essential for effective implementation in all areas of the institution, including those involved with instructional design. These elements include, (1) recognizing the dual nature of the structure of institutions of higher education, (2) enlisting the top management of both governance authorities at the outset, (3) providing training for each, (4) relating the elements of Quality Improvement to each group in appropriate ways, (5) using the elements of common concern as a bridge to cooperation and mutual support.

Liberal Arts Biology Open Lab for Freshman Students: A Case Study in Long Term Multimedia Development

When Mountain View College opened in 1970, the Biology department divided the introductory courses into classes for major and non-major students. Research at El Centro College of the Dallas County Community College District (DCCCD) had shown that combined classes of biology majors and non-majors was detrimental to both groups. Non-major students were exposed to material only needed as a basis for future biology courses and missed the enrichment to be found in involvement in environmental and lifestyle issues. In mixed classes students majoring in biology were unable to receive the in depth experiences that would help them determine the future direction of their studies in biology.

In the DCCCD, classes for students majoring in Biology, pre-med, pre-dental, nursing and other related fields were traditional lecture/lab courses. These classes were exact replicas of their counterparts at local universities with the exception that classes are generally small and the lab portion was taught by senior faculty.

The DCCCD non-science majors classes were based on the Postewaite model with general assembly sessions small assembly sessions and independent study. At Mountain View College a college-wide testing center was added and for a short time was used as a site for testing biology students as well as for many other classes at the college. The number of biology students and the frequency of tests for biology students however soon overwhelmed the testing center and a revised testing procedure was instituted in the biology lab. The introduction of Scantron to PC hardware and the use of powerful PC based software (ParScore and ParTest) allowed the lab staff to handle the more than 1800 tests and credit generating exercises each semester. In time the general assembly sessions lost much of their impact and were supplanted by additional small assembly sessions. Eventually, the small assembly sessions were replaced by video presentations and one to one instruction, or traditional lectures. Much of the Postewaite model was retained, however, and is still in use over twenty years later. The program has proven to be very popular with students, and the classes have been a "sellout" virtually each semester.

During this period, the staff continued to produce audio and video presentations. Video topics included basic genetics, photosynthesis and respiration, metric system, scientific notation, buffers, succession, relaxation techniques, microscope, and cell processors. While many of these early attempts were "talking head" presentations, some involved field experiences that proved to be very useful. It was determined that extra experiences in these areas were needed. The new videos produced used the college's studio and 3/4 inch editing capabilities. Many of these videos have been since been revised or replaced with new materials. As more commercial videos, tapes and video discs have become available, the need for additional local productions has changed in nature. Currently productions are more closely focused on local issues of health, the environment, ecology and biology of North Texas. For example, a recent tape that will be transferred to disc format for use in interactive instruction involves the field identification of wild flowers indigenous to the Dallas area.

In 1986 an extensive review of the state of computer- aided instruction was instituted at the college. Mountain View College President, Dr. William Jordan, Jim Corvey, Director of Educational Computing and a faculty team including biology instructor Larry Legg conducted site visits, scheduled demonstrations, and reviewed the literature in the areas desktop video production and interactive instruction. Following this process Dr. Jordan, at the recommendation of the Larry Legg, authorized a complete remodeling of the non-science labs and the purchase of two MS-DOS 386 development stations and sixteen MS-DOS 286 student stations for use in the biology department. This was the beginning of multimedia interactive instruction for non-science major students in Biology at MVC. The development stations have recently been replaced by 486 systems and plans include upgrading student presentation stations to 486 machines in the near future.

Multimedia at use in the lab encompasses a great variety of instructional materials, each serving a specific purpose. The materials used in the course can be rated from lowest to highest according to the level of student interactivity. The lowest level is found in tutorials purchased from a variety of sources. These include standard topics such as the heart, genetics and evolution. Comprised mostly of textual material, the units are linear and progress only when the student gives the correct answer. No directions or hints are offered when incorrect answers are chosen. The tutorials are inexpensive and usually have low level graphics or no graphics. These tutorials have been used as models in some cases to create similar programs with higher levels of graphics. Both 2-D and 3-D graphics have been incorporated into updated linear programs. These programs currently run as stand-alone parts of the multimedia system.

2-D and 3-D animations produced by the staff of the biology department are vital to the understanding of molecular, chemical, cellular and physiological processes. They are also beneficial, helping the students understand complex process such as evolution, geology, and aspects of embryonic development among others.

At Mountain View, 2-D animations have a history that dates back to the early 80's. Show Partner was used to produce several EGA level tutorials. One program on Photosynthesis did such an outstanding job of instruction it was in use for ten years. Autodesk Animator, a program currently in use, has proved to be much more versatile and useful tool than previous systems. With current programs, 2-D animations can be created in a short time and are especially useful for creating lessons rapidly when students fail to understand a topic currently being studied.

Computer graphics and animations have also proven very useful to students lacking developed skills in visualization. Visualization, a skill honed by reading and conceptualizing images, is necessary in order to understand many of the processes that are not directly observable in biology. While the production of graphics and animations have sometimes proved difficult and time consuming, the students have benefitted from the effort. The animations apparently have the same appeal as cartoons and animated movies, thus many students see the process of learning as fun.

Several 3-D animation segment are currently in progress or are being planned. In one the biogeochemical cycles interacting in an ecosystem is used to teach the basic principles of chemical interactions. Typically, illustrations in textbooks show each cycle as a separate illustration. Students often find it difficult combine the illustrations into a coherent whole and visualize all the cycles influencing each other as seen in Liebig's Law. In another, the concept of recessive genes, difficult for many students to grasp, follow such a gene through many generations. The movement of each of the food molecules from ingestion to utilization and the movement of an oxygen molecule from inhalation to excretion will follow the food processing cycles using animation to bring the process to life.

Another component of the total system is based on computer generated games. All major topics have interactive crossword puzzles that can be solved using the vocabulary of biology. Word Search is also currently under development. Both games help build the students biology vocabulary. Several memory matching games have been developed. One game, matching a graphic of the stages of Mitosis and Meiosis with their name, has proven very popular. Additional turn-over and match games are planned for Chemistry, Anatomy and Diversity.

The development of multiple information and visualization sources produced, managed, and delivered by computer has provided a unique opportunity to make a major transformation in the nature of the way biology for non-science majors is taught. The conversion of the fact giving approach utilized in most Biology courses to one of discovery and inquiry is under development by the biology faculty. Many have lamented the inability of students to apply critical thinking to problems encountered in and out of the academic setting. It is true that students have had little practice in critical thinking. Only a few courses and teachers take the time and effort to foster such an approach. If students have not practiced this technique, how can they be expected to apply in their course work. For this reason and to help the students face the decisions they must make daily, the conversion to a critical thinking approach will be pilot tested in Fall 1993.

The use of sophisticated authoring and presentation programs in the development of multimedia offerings allows for the inclusion of student input and record keeping as a part of the program. Students may try different paths or experiments until they can prove their hypothesis or suggest an alternative hypothesis When the student chooses an hypothesis or test not anticipated by the instructor and consequently not programmed into the lesson, the instructor will act as a mentor to help the student re-channel their efforts. Should the student present a valid alternative view, it can quickly be programmed into the system.

Various levels or starting points of the critical thinking system can be programmed. At the simplest level, students can be given an hypothesis and asked to select data that will prove the hypothesis. At a more challenging level, students may be given data and asked to form an hypothesis. The most rigorous level will provide the students data, have them to form an hypothesis, design experiments to support their hypothesis and form a conclusion based on the process. All of these methods are programmed into the multimedia interactive system by combining various authoring systems, and a profusion of media.

This system allows students to practice critical thinking methods by testing alternatives and developing their thought process in a non-threatening environment. Several authors have suggested that practice is the missing ingredient in the inability of students to use critical thinking processes. Multimedia interactive instruction overcomes this hurdle in a relatively inexpensive and student centered fashion. Multimedia interactive instruction offers the instructor the ability to quickly adapt to the students ever changing needs, yet utilize many of the existing materials.

The latest developments in creating instruction in a mutimedia format are taking into consideration the colleges commitment to TQM. The processes and statistical treatments available through TQM and Classroom Assessment Techniques (CAT) are being implemented in the formative stages of development. As the use of Laser Disk,

CD-ROM, and networking become fully operational the summative evaluation will be developed extending the research.

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USING MULTIMEDIA WITH LARGE LECTURE SECTIONS, DOES IT WORK?

Arnold J. Karpoff and Carolyn Rude-Parkins

ABSTRACT

In theory, multimedia presentations in large lecture sections should provide a medium by which instructors can impact on the diverse learning styles present in the lecture hall. Whether it works or not depends a great deal upon how you measure success, purely by numbers or also by student perceptions. We feel that both can be important academic assumptions.

INTRODUCTION

The purpose of this paper is to discuss the development and use of multimedia presentations with nonscience major students in a large lecture section format. The following points are explores:

1) trend to use multimedia and nontraditional instructional strategies,
2) diverse learning styles of students in large lecture sections,
3) course development and gradual transition to multimedia,
4) impact on students and teacher.

TREND TO MULTIMEDIA

Historically, print media--textbooks and illustrations--have been the predominant tools for instruction and learning. Print is, however, limited in its ability to convey certain complex as well as abstract concepts in biology as well as other disciplines. In the past few decades, we have included the use of film and video and have found that it has eased our reliance on print and provided an interesting and powerful way to illustrate processes and principles, attitudes and values. More recently, computer technology has made possible an instructional environment that combines print, still graphics, animation, sound and motion sequences. One advantage of the computer medium over others is that it provides an immediacy in revision and updating not available with the print media. Computer-augmented presentation platforms have a sharp learning curve and can be used effectively by faculty with minimal computer programming skills. The hypertext based programs can be easily modified to meet the requirements and skills of individual instructors.

With computer technologies it is now possible to flexibly integrate various media resources into instruction and to provide a degree of immediacy and interactivity under teacher control that has never before been possible. Multimedia lessons can visualize and illustrate subject matter in ways that appeal to diverse learning styles. Nontraditional and cutting edge instructional strategies, such as cognitive learning strategies, can be integrated into instruction and used for teacher experimentation. In 1897, John Dewey advocated training students' power of imagery and seeing to it that the students continually formed definite, vivid and growing images of the various subjects studied. At last, multimedia gives the tools to do this for many.

DIVERSE LEARNING STYLES

The audience addressed in this study was non-science major undergraduate students in Introductory Biology. The students vary in age and include recent high school graduates as well as adult students, most of whom are working full or part time. Introductory Biology is one of a number of science courses available as part of the general education requirements for all university students. It is a required course for some majors, but for most it represents a selection from a group. This course attracts students with varied abilities, aptitudes and motivations for the subject.

Budget cutbacks, in this as in other state universities, have led to increasingly large lecture class sizes. This class was taught in a 400-seat lecture hall equipped with a multimedia instructor station and large screen projection capabilities. The facility was designed with the premise that multimedia will "reach" more of the students in a more cost effective manner.

The diverse learning styles represented in such a class can be described in several ways. Learning style modalities are auditory, visual, tactile/kinesthetic and combinations of each. Research says we learn most of what we know through visual (75%) and then auditory (13%). Combined auditory-visual presentation results in 6 times

greater learning than just auditory (Wileman 1993). Much traditional instruction is auditory through the teacher's voice.

Learning style modality is related to right and left brain learning. Left brain is verbal and sequential, uses symbols and logical sequence, sees the parts before the whole. Right brain is visual and spatial, uses patterns and random order, sees the whole before the parts (Bogan, et al. 1969). Each brain has a favored way of processing information but learning is better when both brains are used. The left brain prefers lectures, demonstration, memorization, giving answers and solving problems. The right brain prefers interaction, trying it, asking questions of the expert, finding problems and imagination. In a reported study in 1980 high school students were 46% right brain, 28% left brain, 25% integrated.

Learning style modalities imply teaching strategies that provide for auditory, visual and kinesthetic input. Multimedia instruction can provide a means by which the instructor can use all of these modalities to create a more complete presentation. The capability to design graphic materials that evoke visual thinking strengthens the instruction. Visuals can simplify complex concepts, clarify abstract language-based concepts, present more information in a given space and increase retention (Wileman 1993).

This study addressed learning style modalities as a dimension of student diversity with potential to be met by multimedia instruction. Multimedia presentations were projected on a 10 x 15 foot screen. This very visual instruction created a variation on student note taking behavior that seems to exist in lectures in general -- if it is on the blackboard, write it down. With multimedia it has become -- if it is on the screen, copy it down. One of the expected byproducts of computer instruction was additional lecture time available from the elimination of chalkboard writing. This benefit was not realized as the students still needed the time to write everything shown on the screen before the instructor could move on. The instructor felt that the time spent copying detracted from listening and learning. In an attempt to solve this problem, all the screens used for one topic per each exam were converted to a fill-in-the-blank format and were printed. It was anticipated this would reduce the time spent copying material because the student could look at the screen and only have to write in the missing material.

GRADUAL TRANSITION TO MULTIMEDIA

Biology 103, An Introduction to Biological Systems, is the most important of the general education service courses taught by the Biology Department. All combined sections of the course reach approximately 1,500 students each year. Students meet twice a week for a total of 160 minutes of lecture, then break up into 16 sections of 24-26 students for two hours of laboratory each week. Within the next year, 85+ percent of these students will be enrolled in the multimedia version of this course.

In 1991, the instructor devised a 4-stage plan to convert the traditional instructional materials into multimedia format.

1. Toolbook, a hypertext-type Windows platform authoring software was used to convert the traditional chalkboard lectures into presentation "books." One extremely helpful technique was sequential disclosure, a right brain type approach, which allows the instructor to focus student attention on varied aspects of the visual as they are discussed. Twenty-one "books" have now been created, some of which take two or more lecture periods to complete. These "books" contain the presentation graphics and utilize the nonlinear linking property of hypertext programs to organize the material around a number of anchor menus. The "books" represent the minimum material necessary to modify the course. Other modification phases are built upon this base.
2. Graphic materials were added in the next phase. Black and white as well as color images were scanned by means of the Microtek MSF 300 flat bed scanner and a Typist hand scanner. Scanned images invariably needed to be edited by adding or deleting text or other items, and by enlarging the type size to be legible in the lecture hall.

   A problem was created by the large file sizes of the color graphics which slowed ToolBook's page transition speed. One solution involved the use of the dynamic linking property of hypermedia sysbooks to create a bitmapped image "book" that, although large in size, is only accessed one or two pages at a time as needed. At the present time, the availability of a Canon Visualizer reduces the urgency of this part of the project and will allow time to work out the dynamic linking scripting needed. The recent introduction of the Kodak Photo CD system has added a new set of possibilities to this portion of the project. Any set of visuals can be transferred to 2 x 2 images which can be professionally copied to the Photo CD to create user-defined images. The Photo CD should be easily interfaced with the computer presentation system through the use of an electronic switcher already available as part of the presentation hardware.

3. Laser video disc clips are currently being inserted into the "books", using the multimedia-extensions available with ToolBook 1.53 and the IBM academic computing software. The only limitation is shortage of money to purchase suitable video disc materials. As a number of book publishers are currently producing high quality videodiscs to go along with their textbooks, the availability of course-specific visual information is increasing.
4. The fourth level of the project includes the conversion of the lecture hall "books" into student tutorials for use by individuals or small groups on their own or university PCs. The learner will be able to interact with the program to review material presented in lecture and to obtain additional practice on questions and activities. The printed workbook used by students in the course will continue to serve as the anchor around which the multimedia materials are designed. The tutorial materials are being produced with the assistance of an undergraduate premedical student, supported by a grant from our Provost's Office. The use of such undergraduates as producers as well as representatives of future consumers of this material provides a unique learning experience for them and for the faculty member as well. Their energies and different perceptions result in more student- centered materials.

IMPACT

The multimedia instruction has been enthusiastically accepted by the students. Student evaluations in fall and spring semesters include many unsolicited comments supporting the presentations. Students were impressed with the color, the animation and the legibility of the type which makes note taking easier. The first time each semester that either animation or full motion is used, there are audible gasps in the audience.

The traditional proof of effectiveness of any new technology typically involved measurement of student performance by exam scores before and after or between experimental and control groups. Most published data seems to indicate that multimedia presentations have not improved student performance (Kearsley 1993). Janda (1992) in his study of a course in American Government, found no difference in exam scores. He discussed two lessons learned from his studies. First, students distinguish between what they like doing and what they think helps them learn and they hold a narrow view of learning as "what helps them on the exam."

His observations were confirmed by an experience in the Biology class. The professor was using the visualizer to project an image of the kidney as part of a lecture on excretion. One student in the rear raised his hand to ask whether the diagram would be on the next exam. When told "no", the student then proceeded to ask "then why is it being shown."

The second lesson was, despite very positive assessments of the multimedia sessions, students did not translate their feelings into any greater store of knowledge of the subject or any greater inclination to take another course in the field.

Casanova and Casanova (1991) reported similar experience in using multimedia to teach organic chemistry. Rather than negatively evaluate their experiences, they provided a thoughtful analysis of their findings. They conclude that the electronic blackboard conveys to students a different set of priorities within the discipline that may or may not be tested by the instructor, but may be important in the student's future work.

Sooner or later, those who invest time and effort in developing multimedia presentations are going to be asked about effectiveness. We must begin to examine our evaluation methods. Using traditional testing methods to evaluate learning from nontraditional instruction may be self-defeating. We should be able to show that multimedia instruction contributes to learning through students expectations and perceptions as well as by tests of content mastery.

In this study, computer-generated fill-in-the-blank handouts were given to students in eight of the sixteen lab sections to create experimental and control groups. The students were asked at the end of the semester to complete a questionnaire about the perceived usefulness of the handouts. Exams taken by the experimental group were separated from the rest of the class and the scores on questions covered on the handouts was compared between groups.

Although full analysis of this data is not complete, it appears that there is no difference on exam performance between the two groups. What is most interesting is the results of comments made during the semester, as well as comments written when students were asked to complete a standard course evaluation. Many students whose lab section did not receive the handouts were vocal about not getting them. From almost the first day these handouts appeared in class, there was the perception by the "have nots" that these handouts were a useful addition. These perceptions were mirrored by those who received the handouts. These handouts did in fact accomplish the original goal. Students who used them reported they felt more comfortable in the classroom less lost, able to listen better, and that the handouts should be expanded to cover all the lectures.

Why these positive feelings were not translated into a better performance on the exams cannot be easily explained. Perhaps new methods of instruction require new methods of evaluation. We are of the opinion that even if there is no quantitative difference between the two groups there does exist a qualitative difference. This difference may not be scientifically demonstrable but exists in the classroom experience and in the perceptions of the student consumers, who learned more than they thought they would. The presentation of the material involving a mix of audio and video media coupled with the limited use of the computer notes leaves the students with the feeling that perhaps science isn't all that boring and can be presented in a way that appeals to the combinations of varied learning styles represented by these students.

For the instructor, ToolBook offers a medium for self-education and a chance, on the more esoteric side, of personal renewal (of his/her purpose when he/she decided to teach). It is very easy for an instructor to become complacent and to continue to teach, semester after semester, without any real thought as to the effectiveness of that teaching method. While assigning a grade to a student for a given course is sometimes a relatively simple procedure, assessing just how much a student has actually learned is much more difficult. ToolBook offers the instructor a way of tailoring every semester's coursework to the group of students involved. Previously, new information would be included in an existing course as an "add on," but it can now be immediately integrated into the materials. The instructor can constantly learn and expand the presentations to better instruct the student.

CONCLUSIONS

Multimedia technologies are becoming available to increasing numbers of faculty. As they begin to use these technologies, they find that they have to rethink the ways in which they have traditionally taught and make the appropriate changes to take full advantage of this new teaching system. Multimedia presentations can be constructed to take advantage of learning style differences among student populations. Development of multimedia instructional materials is not difficult but it does take a certain degree of dedication.

Early analysis of student data seems to corroborate other studies in finding no significant differences in student performance as measured by exams. But student perceptions indicate they enjoy the combination of audio, graphic, full motion video and text combined with the handouts. A larger percentage of student comments indicate they have a more positive attitude about science.

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VISUALIZING SPATIAL RELATIONSHIPS: A MULTIMEDIA TRAINING ENVIRONMENT

Trish Russo and Lyn Mowafy

ABSTRACT

We describe a multimedia project for training fighter pilots to read and interpret the F-16's HUD symbology. This low-cost, portable system creates a three-dimensional world in which pilots can interact in a natural and intuitive learning environment with targets that normally could not be seen.

INTRODUCTION: THE PROBLEM OF SITUATIONAL AWARENESS

In an environment of flight, threats, and mission, the fighter pilot must understand his spatial relationship to other aircraft well before acquiring visual contact. The success or failure of his mission can depend critically on his ability to create a mental model of the situation and know enough relevant information to accomplish the intended task. They call this ability *situational awareness*. Unfortunately, a major challenge to acquiring situational awareness during air combat involves visualizing the information displayed on the Head-Up-Display (HUD) and radar scope.

Pilots can use the information displayed on the HUD and radar to estimate the location and direction of flight of a target that has been detected by radar, but is still too far away to be seen. While all the relevant spatial information for situational awareness is available on the spatial instruments of an Air Force F-16 aircraft, it is very difficult to read and interpret. The displays are cluttered, and three-dimensional spatial information is fragmented and scattered. As a result, student pilots must devote considerable time and effort to studying the radar and HUD symbologies. Suppose, however, that the training environment could augment this component of F-16 pilot training by coordinating the spatial instrument information with visual displays designed to reveal the unobservable. Could such a tool reduce symbology training time and demonstrably improve situational awareness?

A variety of training media already provide visual enhancements for training spatial instrument symbology. Until recently, however, they too consisted of two-dimensional representations coupled with digital data tags. The technology had limited capacity to stimulate the trainee's natural ability to visualize the three-dimensional spatial relationships represented in the cockpit instruments. Therefore, subject matter experts in F-16 training have continued to express the need for a three-dimensional visualization tool that would represent directly the intercept space. Recent developments in the multimedia technologies have provided a possible solution to these needs. In this paper we describe an interactive, multimedia training environment developed for the Air Force at the Armstrong Laboratory, Williams AFB to augment radar/HUD symbology training.

PROJECT GOALS

The *Spatial Cognition Multimedia Trainer* is designed to capitalize on a variety of visualization tools in training fighter pilots for situational awareness. In developing this project we sought to develop a training system that could fulfill two functions:

- It would provide a natural and meaningful mapping between the two-dimensional spatial displays, such as those found in the cockpit of an F-16 fighter aircraft, and the three-dimensional spatial relationships of unseen targets to the student pilot's aircraft.
- It also would serve as a model heuristic to stimulate and promote the use of mental imagery in interpreting the spatial relationships described by the symbology of the cockpit data displays.

In addition to the dual-functionality of the trainer, a critical constraint on this project was that it must be implemented on low-cost, commercially available equipment which could be deployed at a variety of training sites. All equipment and software must be portable, and easy to maintain and to upgrade. Of equal importance, it should provide an intuitive user interface. These constraints required that we weigh critically the cost of implementing a training tool with the expected benefits in improved performance and shorter training time. On the other hand, the constraints also necessarily imply that there would be limitations on the sophistication of a visualization tool developed at any given time.

Because the field of low-cost interactive computer graphics systems is growing rapidly, our program was conceived as developing in phases over the next three to five years. We anticipate the potential for high fidelity, flexible systems in the near future, designed for integrating multi-dimensional data in a highly immersive virtual environment. However, initially we have been exploring the problem within a fairly simple interactive training

environment. For virtual environment training functions, the trainer has been coupled with a second computer. Although simple in design, this visualization project is developed sufficiently to represent the unique benefits and constraints of various formats.

PROGRAM DEVELOPMENT

The trainer was developed on a Macintosh Quadra 950 computer using Aldus SuperCard™ software with SuperTalk™ scripting language. Because SuperCard does not presently have the capacity to allow real-time manipulation of objects in three-dimensional space, we created a pseudo-interactive system using Virtus Walkthrough™ movies. Additional video segments were created using a set of hardware and software packages that together composed a convenient and serviceable multimedia bundle consisting of a VideoSpigot™ NuBus with ScreenPlay™ and Adobe Premier™ software. Hidden levels of SuperTalk scripting for the individual cards and card buttons, coupled with QuickTime XCMD's™ in the project overview resource list allowed SuperCard to play Quicktime movies on individual cards. Color graphics and photographs were scanned with a Howtek color scanner; prior to importing them into SuperCard, the images were manipulated and enhanced using Adobe Photoshop™. The remaining graphics were created with Deneba Canvas™.

The trainer offers a multimedia environment hosting a variety of tools and capabilities. In use, the student proceeds through a self-paced tutorial in which text-based lessons are elaborated with graphics and video clips to emphasize and clarify critical spatial concepts. The trainer provides descriptive information about the spatial properties between two aircraft and teaches the user how to find and interpret the appropriate data values on the radar and HUD displays. To demonstrate how the spatial properties are integrated into a single description of the target's location, it offers numerous exemplars of the target in space coupled with the corresponding data displays. The trainer also offers the student a variety of ways to apply one's knowledge through practice. In the practice portions of the program, the user can change the data presented on the spatial display to observe the resulting changes in the position of the target. Finally, the program offers practice in a target recognition task. In this case, a display is presented with a set of model aircraft in a multiple choice task. The student selects the appropriate alternative and receives feedback. For testing purposes, both the manual control and the target recognition tasks can be monitored.

A primary reason for selecting the Macintosh platform for creating this training environment was that this system and its supporting multimedia software are highly conducive to rapid prototype development. Our goal in this initial phase of development was to demonstrate the feasibility of creating an interactive three-dimensional spatial cognition trainer that could be field-tested within a few months of initial conception. Although the development of this project was not without problems and obstacles, we were able to complete it rapidly and efficiently. It is now in use as a research tool at the Armstrong Laboratory, Williams AFB, AZ.

EVALUATING TRAINING EFFECTIVENESS

Because greater psychological realism and reduced cognitive integration load are the anticipated benefits of computer-aided visualization systems, there is considerable anecdotal evidence to recommend the use of three-dimensional computer graphics in education and training [1, 2, 3, 4], medical imaging [5, 6] scientific visualization [7, 8], computer-aided design [9] and remote teleoperation [10]. To date, however, little experimental attention has been devoted to exploring the utility of interactive three-dimensional displays for apprehending spatial relationships. Nevertheless, from a training perspective we need to know whether a medium contributes significantly to optimizing training resources. It should be implemented in a training program only if it presents useful information with a minimum of distortion, ambiguity or irrelevant information. At present, we are conducting a series of studies to evaluate multimedia spatial visualization training systems.

In a series of studies, various types of spatial visualization media have been yoked to the Multimedia Trainer to train subjects to interpret and integrate spatial information presented on a simulated HUD display. Each study has been designed to teach the subject about a specific property or properties of a target's spatial location. For example, in one experiment the Multimedia Trainer was modified to teach the subject how to judge azimuth (the angular separation of two aircraft) and aspect (their relative orientation) by interpreting the HUD. Following the multimedia tutorial, the subject practiced locating a target in a "pick and place" task using 2D-orthographic, 3D-perspective and virtual environment formats. In order to accommodate the virtual environment display, an XTAR Falcon 386-PC™ was used for the "pick and place" practice session. Following practice, the subject was presented with a large scale (16' x 8' by 90° field-of-view) perspective display that simulated an out-the-window view of a target. The task was to judge whether the target's position matched a sample HUD. Our results have indicated a

significant performance difference between the 2D and 3D formats. Clearly, 3D formats in the training environment can produce more efficient and accurate target identification in large-scale spaces.

SUMMARY

In summary, the goal of this training research project was to develop a multimedia system designed specifically to train pilots on the interpretation and integration of cockpit symbology. Our goal was to determine if a low-cost, portable system could be realized that would not only provide a mapping the two-dimensional data display information onto three-dimensional vast virtual environment, but also would serve to stimulate the user to engage imaginal resources for creating a mental model of the engagement. We have developed this system using personal computers and a variety of commercially available software packages. Future project goals include developing a stand-alone virtual environment training system on a single computer platform. Research is now in progress to assess the utility of this type of system for training tomorrow's fighter pilots.

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ABSTRACT INDEX

A PRACTICAL GUIDE TO INTEGRATING MULTIMEDIA INTO HIGHER EDUCATION

Mary Jac M. Reed

ABSTRACT

Successful multimedia integration into higher education requires faculty interest, administrative approval, and support from the academic computing and audio/visual staffs. Introducing multimedia on campus needs a combination of glitzy introductions, successful seed projects, skilled project management, and a lot of cheerleading.

This hour long presentation chronicles success stories on two campuses that were not involved with multimedia instruction at the outset. As a result of continued campaigning and support on the part of the computer center and widespread interest on the part of key faculty, there was use of multimedia in disciplines that had not widely used computers before at the end of two years.

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BASIC CAI TUTORIAL DESIGN

Michael E. Petty

ABSTRACT

Computer-assisted instruction (CAI) tutorials are perhaps the most challenging and most promising of the various CAI models because tutorials may employ elements of each of the other modes (presentation, drill-practice, game, and simulation). Whether the CAI tutorial is text only or incorporates dazzling effects, its values resides in its basic instructional design. The elements of basic CAI tutorial design includes description, objectives, overview, content and application, review, and mastery test.

Description - a concise statement of the purpose of the CAI tutorial, major topics covered, and any special emphasis.

Objectives - explicit learner outcomes. [Upon completion of this CAI tutorial you will be able to...]

Overview - a preview of the major topics.

Content and Application - the main presentation; what it is the user is to know and know how to use. Information is presented with as much user control of pacing, sequencing/branching, interactivity, and feedback as is effective and efficient.

Review - a review of the major topics.

Mastery Test - a test to verify the user's mastery of the content and application of the CAI tutorial.

Features that may be embedded within this overall design include menu selections, windows, icons, prompts, screen forward/back, pre- and posttests, answer analysis, scoring/recording, color, sound, graphics, animation, full-motion video, touchscreens, and printouts.

As fascinating as these features may be, however, they are subordinate to the basic instructional design of CAI tutorials: description, objectives, overview, content and application, review, and mastery test.

The CAI tutorial that is used to demonstrate the structure of CAI tutorials, "Training Objectives," was authored by the presented. "Training Objectives" is based on Robert F. Mager's Preparing Instructional Objectives.

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BUILDING LARGE HYPERMEDIA SYSTEMS USING OBJECT ORIENTED PRINCIPLES

Gustavo Rossi, Alicia Diaz, Silvia Gordillo, and Mariono Bibbo

ABSTRACT

We present object oriented model for authoring-in-the-large of hypermedia systems. The model provides construct for describing not only conceptual relationships between nodes, but also for creating templates defining nodes appearance. We also introduce examplars that are hierarchically classified, (like in Object Oriented Programming). We use them to define prototypes nodes that describe instance-specific information. Applications in the field of education are deeply described.

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BUSINESS APPLICATION FOR THE DISSEMINATION OF ELECTRONIC INFORMATION

Jeffrey A. Bradley and Murray Wilson

ABSTRACT

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CREATING PRACTICAL MULTIMEDIA PRESENTATIONS

Emilio Ramos and Al Schroeder

ABSTRACT

A multimedia authoring system created and used by educators in the Dallas County Community College District will be demonstrated. It incorporates use of test, graphics, sound, animation, and digital video. The demonstration will include a brief lecture using the system, followed by a guided tour of the development and modification of a presentation outline.

DESCRIPTION

A multimedia authoring system created and used by educators in the Dallas County Community College District will be demonstrated. This system incorporates a wide range of multimedia elements such as text, graphics, sound, animation, and digital video, to create presentation that come alive in the classroom. The demonstration will include a brief lecture using the system, followed by a guided tour of the development and modification of a presentation outline.

Participants will receive insight pertaining to contemporary use of multimedia techniques in use in the classroom at Richland College. Additionally, some realistic views of the use and incorporation into the classroom of such technology will be discussed. Finally, the cost and benefit of use of multimedia technology will be reviewed.

The audience for this presentation is any faculty interested in incorporating innovation into their classroom activities. The intended audience should possess a basic level of computer literacy that includes knowledge of Microsoft Windows. Any staff and administrators interested in the use of multimedia technology will also benefit from this presentation.

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DEVELOPING AN INTERACTIVE TUTORIAL USING TOOLBOOK: SOME PROBLEMS AND SOLUTIONS

Rajiv Malkan

ABSTRACT

TookBook is used to develop multimedia applications in the academic world. This presentation will assist the audience in proper design techniques for creating interactive tutorials using ToolBook. The presentation will focus on the interactive DOS tutorial developed by the presenter. Handouts, shortcut methods and solutions to the problems encountered will be discussed.

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ELECTRONIC PRESENTATIONS, VIDEO EDITING, MULTIMEDIA? WHAT IS IT?

Marlene Augustine

ABSTRACT

It's VideoShow! For more than 10 years, General Parametrics has been in the business of making electronic presentations easy. Now they have gone the next step; adding full motion video and sound. It's simple, using products you're already comfortable with - your favorite applications packages, VCRs, video cameras, camcorders, laserdiscs, scanners, etc.

Marlene Augustine
Lanier Presentation Systems
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ENHANCING THE CURRICULUM THROUGH THE INTERNET

Catherine M. Townsend

ABSTRACT

The presentation will demonstrate how curriculum, K - 12, can be enhanced by resources and contacts established by both teacher and student through use of the InterNet. The InterNet is a world wide network of interconnected smaller computer nets that allows individuals from any part of the world to exchange data with any other part of the world. The specific curricular area to be demonstrated is in the social sciences. The demonstration will show how students can research, compile and share with others across the nation and around the world their own local culture and history.

Specific examples of already existing InterNet Discussion Groups will be shown. Some of these are:

KIDS93	SERVE	AT&T Learning Link FrEd Mail
IRIS	LM_NET	NAT. GEO KidsNet
I-EARN	ACADEMY ONE	WORLD CLASSROOM

This presentation will also demonstrate through actual use, how presentations and talks can be enhanced by using a computer, LCD screen and software package called PC COMPANION. This package allows the presentator to capture graphic images originated by the author, scanned in or "stolen" from another program on a VGA monitor, to a disk file and then present them in sequence with fairly sophisticated visual effects.

Presentation Type: Demonstration/Lecture

Technology: Instructional/Networking (Use of . . .)

Anticipated Audience: Intermediate/Advanced (Application . . .)

Equipment Needs: PC 386 or higher, 3 1/4 high density drive, VGA color monitor, LCD color display screen, large screen, VHS VCR.

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Resource Consultant
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HYPERMEDIA- INCORPORATING SOUND, LASER DISC, AND SCANNED PICTURES INTO HYPERCARD

Diana Gearhart and Carole Hruskocy

ABSTRACT

How two teachers use hypermedia to get students excited about learning in language arts, science, and social studies. See actual projects created by 6th grade students and learn to create your own.

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Carole Hruskocy
Teachers
Nathan Hale Elementary
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INSTRUCTIONAL INTEGRATION - MULTIMEDIA IN THE CLASSROOM

Carl Koenig, David Curtis and Mike Palmer

ABSTRACT

This session is designed to demonstrate the results of a one year project conducted for the Missouri Department of Elementary Education. The overall purpose of the grant was to assist six teachers (two junior high, two high school, and two community college) to incorporate multimedia technology (i.e., computer video project system, laserdisc, CD-ROM, and multimedia software) into existing classroom presentation.

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INTEGRATING TECHNOLOGY (MULTIMEDIA) INTO THE CLASSROOMS AT UTAH VALLEY COMMUNITY COLLEGE: A UNIQUE APPROACH

Ralph T. Merrill, James E. Barnes and Dennis A. Fairclough

ABSTRACT

The three presenters will use computer drive slide shows and multimedia demonstrations to inform the audience about:

A. how multimedia is being evaluated, selected, and integrated into classrooms,
B. why a new Teaching/Learning Center of Excellence (TLC) has been formed and how the faculty are being motivated to use multimedia, and
C. how the faculty are being prepared to use multimedia in classrooms at UVCC.

The activities of our presentation will be to share with the audience by spoken word, computer driven slide show, and multimedia equipment demonstration a summary of our findings as we have researched, evaluated, and started integration of technology (multimedia) into our classrooms. Our objective in presenting at AAIM-93 is simply to motivate more people into using technology in their presentations thereby improving the quantity and quality of learning that occurs there. We have developed strong opinions about how best to prepare and motivate teachers to use technology in the classroom as well as what technical equipment is best suited for use today. The content of our presentation will be as follows:

A. Presenter Merrill will describe how multimedia technology is being evaluated, selected, financed, and integrated into Utah Valley Community College classrooms.
B. Presenter Barnes will describe why a new Teaching/Learning Center of Excellence was established at UVCC and its relationship to the emerging multimedia technologies. He will also discuss the procedure used to infuse motivation into the UVCC faculty to use multimedia. He will demonstrate the capability of our multimedia systems.
C. Presenter Fairclough will describe how UVCC faculty are being prepared to use multimedia. He will demonstrate the ease of use of the multimedia system by actually creating a short presentation in front of the audience. His demonstration will use a notebook computer, color LCD projection panel, high intensity overhead projector, color document scanner, CD-ROM reader, and several software packages. This demonstration is typical of the procedure Professor Fairclough uses daily in teaching students in his classes.

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INTERACTIVE VIDEODISC TECHNOLOGY IN MEDICAL EDUCATION

Thomas Singarella

ABSTRACT

The fundamentals of interactive videodisc technology and how it is being used in medical education will be the focus of this presentation. A foundation and overview of optical videodisc technology for medical instruction and imaging will be provided. Examples from medical videodisc programs from throughout North America will be shown. Useful handouts will be provided to participants.

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INTRODUCTION TO FOREIGN LANGUAGE MULTIMEDIA DESIGN WITH HYPERCARD

George Mitrevski

ABSTRACT

This training session is aimed at the novice HyperCard user. This idea-packed workshop introduces the foreign language educator to the power of HyperCard as an effective language instruction tool. The specific elements of HyperCard (graphics, buttons, fields, music and sound) are discussed, as participants learn how to use them in creating lesson stacks. To get most out of this workshop, the participant should be familiar with the basic operations of a Macintosh, and should have worked through the HyperCard Tour stack that comes with the HyperCard program.

OBJECTIVES

Participants in this workshop will learn how to:

- Implement HyperCard stacks in the foreign language curriculum
- Design and implement various forms of tutorials and exercises
- Make stacks that are easy to navigate
- Develop an idea into a clear and concisely designed stack
- Create stacks and design cards in both linear and cobweb fashion
- Achieve professional results by experimenting with various designs
- Develop user-centered activities that promote active learning

As participants explore the capabilities and limitations of HyperCard, they learn to create individual instructional stacks to take back to the classroom. For those participants who would like to learn beyond the basics of HyperCard, information on the latest multimedia techniques using HyperCard will be presented, and major low cost advances for multimedia productions will be demonstrated. The presenter will discuss program design issues and will demonstrate how to integrate multimedia and hypermedia into the foreign language curriculum.

Each participant will be provided with a resource packet, which will include:

- Language specific bibliography of HyperCard language stacks
- Sources for further information and free stacks
- A working "shell" that can be used to design a foreign language stack

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KB-ITS: A KNOWLEDGE-BASED INTELLIGENT TUTORING SYSTEM

Pervez Ahmed

ABSTRACT

The dedicated Computer-Based Training (CBT) systems are commercially available for teaching and training purposes. These systems are not constructed by using formal data modeling and knowledge representation techniques rather they are developed by traditional language-based approaches. One of the major limitations of these systems is that they are architecturally closed and rigid, and amendments in the source program is the only viable option for incorporating new concepts or functions in the systems. Furthermore, these CBT systems cannot evolve with time; learn and deliver new concepts and fully and effectively utilize technological advances without modifying source programs. Therefore, a CBT application development environment other than traditional environment is required. To provide such an application development environment a project is in progress to construct an intelligent shell.

The shell takes the advantages of the recent advances in: (a) multimedia concepts and techniques developed for effectively managing and manipulating graphics, high-resolution images, motion video, high-fidelity audio; (b) database methodologies for handling the well-formatted textual data known as record-base and (c) knowledgebase methodologies for adding the pertinent knowledge manipulation capabilities. The shell, through its intelligent graphical user interface, allows a user to provide full functional specifications of the application systems which is to be developed and selection of appropriate record-base, image, graphics and audio database, and knowledgebase systems which are commercially available.

Although, integration of heterogeneous available systems involves many issues such as data consistencies and data connectivity but there are many advantages, see list below, of integration.

The integration through a shell provides a formal application development environment whose absence is hampering the growth of multimedia techniques. The integration allows that all components of an application system to be built by using well-established data modeling techniques. The integration allows an application system to inherit all characteristics of heterogeneous component systems.

The integration allows an application system can share already compiled and stored data of heterogeneous component systems.

Shell provides a uniform, high level and collective view of its heterogeneous component systems. Each heterogeneous component system can function as an independent system in its own right.

Currently, we are exploring the potential applications of the proposed Intelligent shell for the construction of application systems. One of the applications we are involved in is the construction of a Knowledge-Based Intelligent tutoring System (KB-ITS). The KB-ITS has capabilities to evolve and learn new concepts and make important assertions about a subject. In this paper we shall present an outline of the Intelligent shell and illustrates its effectiveness in developing a KB-ITS for teaching geometrical concepts.

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KEEPING "IN-TOUCH" WITH YOUR COLLEGE COMMUNITY

Ginger Toth and Debra Watson

ABSTRACT

Monroe Community College wanted to deliver more up-to-date information to students without an increase in administrative staffing. The college installed a microbased, information system called "Campus Information System (CIS)" on five strategically located kiosks. The system interfaces with the college's administrative database system via an Ethernet network. Using state-of-the-art touch display screens, students can view and/or produce printed output of course availability, transcripts, class schedules, degree audits, and demographic information. information for the public includes general college information, faculty/staff directories, campus maps, and calendars and events.

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MAKING DVI WORK: PROBLEMS AND SOLUTIONS

Stephanie Low Chenault

ABSTRACT

Digital video interactive (DVI) allows you to store interactive multimedia on a single large-capacity disk--a portable presentation, which can be displayed in any properly equipped classroom. The College of Charleston is offering faculty workshops on using DVI with multimedia in model classrooms, applying a variety of authoring systems.

Stephanie Low Chenault
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MICRO MARKETING: MULTIMEDIA COURSEWARE FOR BUSINESS STUDENTS

Rick Webb

ABSTRACT

The goal of this project is to create teaching and learning tool for business students in the Marketing area.

A major challenge in the Marketing area is how to bring the student to experience the planning, research, and implementation and control functions of a Market Plan. We have developed a multi-media approach to bring the outside world into the classroom.

Micro Marketing allows the student and or group of students to actually develop a plan that will focus on specific needs of a particular product and allow the student to examine a wide variety of direction from national to regional market plans.

For each main cluster in the courseware, the teacher and or student can explore topics in depth as well as investigate background information.

The courseware utilizes the IBM Advanced Academic System running on the module 57SX "Ulti-Media" machine. Its features include:

- variety of media, including full-motion video, still images, charts, graphics, and audio
- a full range of student-teacher interactions using the toolbook environment
- flexibility to use the courseware as both a presentation tool and a student research and lab tool
- capability of using in multiple classes

The presentation will describe Micro-Marketing and its application via multimedia CourseWare.

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MULTIMEDIA CURRICULUM DEVELOPMENT

Arie Noordzij

ABSTRACT

The Hague Polytechnic developed two modules for students of several departments of library and information studies in which an introduction is offered into the development of multimedia and hypertext databases. The paper will give an overview of the curriculum and will clarify the difference between pure applications and the development of databases (by students) for storage and retrieval of 'multimedia' documents. Special attention will be paid to the 'theoretical (storage and retrieval)' aspects and building multimedia and hypermedia databases. An overview will be presented on the curriculum. Specific demands on hardware and software will be discussed.

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MULTISITE MULTIMEDIA COURSES (E = M C) PROJECT

William Perrizo, Cyrus Azarbod, James Froemke and James Judisch

ABSTRACT

The purpose of this paper is to explore the role of multimedia technology in remote distance teaching and learning. Computing technology is improving very rapidly. Courses designed to cover advanced topics require specific human and equipment resources which are often not available at any one site. The IBM University partners Program (UPP) participant universities, taken collectively, would be able to provide the very best expert instruction in a wide range of topic areas. In this project, we are producing a series of multimedia courses on advanced topics which would be team taught by experts from several different universities and industries. The lecture would be simultaneously delivered to students at several UPP and other sites. Student team projects in which each team consists of students from more than one site are planned, to develop remote teamwork skills.

Multimedia combines the interactivity of a computer with a natural user interface that includes audio, video and real images. Most of the existing multimedia applications have been standalone. In this project, we are combining multimedia in a distributed computing environment with full or partial video motion, electronic mail, facsimile transmissions, and telephone communication.

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NETWORKED VIRTUAL REALITY

Carl Eugene Loeffler

ABSTRACT

The promise of virtual reality has captured our imagination; networks will render it accessible. There can be little doubt that networked immersion environments, cyberspace, artificial or virtual reality, or whatever you want to call it will evolve into one of the greatest ventures to ever come forward. It will draw from and affect the entire entertainment, and the creative arts. It will be multi-national, and introduce new hybrids of experience for which descriptors presently do not exist.

This one hour presentation address the question what is virtual reality, how can it be networked and what are examples?

The major contribution is a discussion of the existing cultural and educational applications, utilizing networked virtual reality. Emphasis will be given to the Networked Virtual Art Museum, a project under my direction produced at the STUDIO for Creative Inquiry, Carnegie Mellon University.

The conclusion forecasts a not so distant future where creative arts studios will be located within networked immersion environments.

Carl Eugene Loeffler a pioneer in contemporary art and communication technologies, is currently the Project Director of Telecommunications and Virtual Reality, at the STUDIO for Creative Inquiry, Carnegie Mellon University. He initiates and directs the projects produced at the facility which he established for the merger of the Creative Arts and virtual reality. His pioneering project, the Networked Virtual Art museum, was awarded in 1992 by EDUCOM for networked information in support of teaching and learning. He is the editor of the forth coming publication, Virtual Realities: Anthology of Industry and Culture, published by Van Nostrand Reinhold.

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REPURPOSING MULTIMEDIA: RECIPROCAL USES OF MULTIMEDIA AND VHS

Kent Roberson and Jerry Zink

ABSTRACT

Repurposing multimedia is using various programs and multimedia equipment as production tools to create integrated instructional products that do not involve multimedia equipment for display. For us the product is instructional and promotional video. We will discuss and display the techniques and processes involved in producing and taping repurposed multimedia.

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SIMPORT - A DECISION SIMULATION TRAINING PACKAGE FOR PC

Enda Hession

ABSTRACT

Simport is designed as a group exercise; each group makes a series of decisions on capacity, technology (renewable or conventional energy options), and equipment suppliers, as would arise in a typical small scale investment project in a developing country electric utility. The final phase of simulation is a retrospective evaluation of the project.

SIMPORT operates under MS Windows 3.1, is based mainly on Turbo Pascal for Windows and includes some 3D animation, colour, scanned images, and sound effects.

Dr. Enda Hession
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TECHNOLOGICALLY ASSISTED FOCUSING - A BREAKTHROUGH FOR CLINICIAN, TEACHERS AND RESEARCHERS

Dennis Raphaely

ABSTRACT

Video, controlled by computer, can be used in psychotherapy to give a couple immediate feedback on how they interact, as well as to cross-reference video-records from other sessions. This new technology can also be used to catalog and retrieve video-records for many types of teaching and research.

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THE ART OF BEING HUMAN - THE WONDER OF FORM
A Laser Disc/Multimedia Interactive Instructional Module

Thelma Altshuler and John Villamil

ABSTRACT

The project is an interactive laser disc program which would allow students to learn more about Plato's theory of form, the essential form, and the difference between classicism and modernism. Resources include sections from the Art of Being Human a college-owned and produced 17 volume video series.

Presentation Type: Demonstration

Anticipated Audience Level: All Levels

This presentation is intended for an audience composed of faculty and professional staff members who are interested in the integration and use of multimedia technology for the enhancement of the teaching/learning environment of community colleges. No computer literacy will be necessary from the audience. Technical description on the how the program works will be presented using a theatrical metaphor. Ideal size audience for this presentation is approximately 50 to 75 participants.

Experience of Presenters: Professor Thelma Altshuler is a well-seasoned presenter, and author of several Humanities textbooks. Mr. Villamil has extensive presentation experience at local, regional and national conferences.

Requested Equipment Rationale: The presentation was developed using a Macintosh IIci with Macromedia Director 3.1 Integration of animation, audio and video was possible using Macro Mind Director and Videologic DV-4000. To run this presentation a Mac IIci with at least 8 MB of memory will be necessary and Pioneer Laservision Player LD-4200. Stero sound amplifier system and full color-full motion video projection equipment are requested.

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USING COMPEL TO CREATE STUNNING MULTIMEDIA PRESENTATIONS

Lorinda L. Brader

ABSTRACT

COMPEL is a brand new full-featured graphics presentation product released by Asymetrix, the producers of ToolBook. Using COMPEL, you can create and deliver shows that incorporate the latest in special effects and multimedia, including text, graphics, sound, animation, full-motion video overlays or digital video. With COMPEL's unique linking and navigation features, you can quickly respond to and interact with your audience. Just click on an object, button, word, or bullet to link to other slides, presentations, or applications. You can also press TwinClick™ to access an on-screen navigation panel that is unique to COMPEL.

You can get the look you want for your message by selecting from over 100 templates included with COMPEL, or you can customize your own templates for use in your presentations. Then choose from a variety of slide and bullet transitions to keep your presentation interesting. You can create high-impact presentations that reflect your own style by including sound, animation, and video. Select from an extensive library of media clips that come with COMPEL, or create your own clips to include in your presentation. Since COMPEL supports Microsoft® Video for Windows™, you can include digital video clips in your presentations.

If you need to travel with your presentations, COMPEL includes special utilities that compress, package, and check your files. Then you can show your presentation on another machine using COMPEL SHOW, the runtime version of COMPEL.

In addition, COMPEL automatically generates overheads, handouts, speaker notes, and slides. So, whether you're about to create your first multimedia presentation, or you're an experienced presenter looking for a way to get your message across more effectively, COMPEL can help you significantly reduce the time and cost of creating stunning multimedia presentations.

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USING THE COMPUTER ALGEBRA SYSTEM MAPLE V IN THE CLASSROOM

Herbert Brown

ABSTRACT

Some see the computer as transforming education the way it transformed industry: teaching more students more quickly and more efficiently. It is better to think of the technology as "Doing something different" rather than "Doing the same thing faster." The intent is to allow students and faculty unprecedented access to numerical, symbolical, and graphical tools that are usually quite difficult to get hold of in the classroom.

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UTILIZING MULTIMEDIA TECHNIQUES IN INTRODUCTORY MANAGEMENT INFORMATION SYSTEMS COURSES

Leah. R. Pietron and Dwight A. Haworth

ABSTRACT

Reviews research results of Kelly Grant, examines multimedia approaches to teach introductory MIS theory and examines design techniques.

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VBI TECHNOLOGY USED TO COMBAT UNEMPLOYMENT IN SOUTH CAROLINA

Jonn Watson and Ruth Marshall

ABSTRACT

South Carolina has put together a high-tech plan to combat unemployment. Job openings (7000 per day) from the South Carolina Employment Security Commission's computer will "ride television waves" of SCETV to the public. It's the same principle used to broadcast information for the hearing impaired. All that will be needed to access the job information is a decoder.

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PRECONFERENCE SESSIONS

Pre-Conference Seminars

To help you learn more about this new and expanding field while earning graduate credit, AAIM is providing hands-on pre-conference Professional Development Seminars in multimedia subjects. Registration for these seminars will be on a first-come, first serve basis, and three graduate credits for the seminar you choose can be provided by the Citadel. (Cost of graduate credit is $105 per credit hour or $315 per seminar.) For graduate credit, The Citadel will assign the conference sessions required for course completion. Or, you may participate without applying for graduate credit for $125. (See the Conference Registration form on page 15 for registration options.

3 Day Pre-Conference Seminars can earn you graduate credit. Select option 1 on the registration form on page 15.

1. Using Linkway as a Development Tool

Learn to produce effective interactive instructional materials using Linkway. A three-credit workshop for teachers, trainers, graduate students, faculty, multimedia practitioners and developers. No previous Linkway experience necessary. Some computer experience is helpful. No programming skills necessary. Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28. (IBM-MS DOS)

2. Advanced Linkway, Linkway Live

Learn to add captured voice, sound effects or music to your existing folder. Add CD audio, enhanced graphics, digitize pictures and full motion to the folder you bring with you. A three-credit workshop for anyone with basic Linkway experience. No programming necessary. Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28. (IBM-MS DOS)

3. Hypercard Courseware Development

Learn best by doing! HyperCard is for you. Leader-lead workshop for teachers, graduate students, faculty, multimedia practitioners and courseware developers. No Macintosh experience necessary. Three credit workshop. No programming skills necessary. Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28.

4. Macintosh Media Integration

This is an advanced three-day, hands-on experience in creating a multimedia project. Integrates selected media types such as animation, scanning, anti-aliased fonts, CD-ROM audio, laserdisc video, audio input and projection, frame grabbing and screen recording. Features QuickTime video editing. Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28. Three credit workshop.

6. Amiga Video Toasters

Learn how to use the "Video Toasters" and Amiga to create and integrate amazing graphics and animation into your video. The Video Toaster is an "affordable" complete video editing system. (Hands on). Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28. Three credit workshop.

7. Virtual Reality, Multimedia and Computer-Aided Design (CAD) in Architectural Design

Learn how Virtual Reality and Multimedia are integrated in a CAD program to enhance the Architectural Design Program at the Savannah College of Art and Design. (Hands on). Architectural Design background not necessary. Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28. Three credit workshop.

8. Toolbook Basics

Toolbook is a multimedia authoring program for the "Windows" environment. Learn how to produce integrated, interactive multimedia products in this hands-on experience. Begins 8:00 a.m. July 26, ends 5:00 p.m. on July 28. Three credit workshop.

9. Video Production and Editing

This session features the use of the most technologically advanced production and editing equipment and facilities. A must for anyone interested in entering the video production field. Begins 8:00 a.m. July 26, ends 5:00 p.m. July 28. Three credit workshop.

All Offerings Subject to Enrollment and Lab Availability.

TECHNICAL SESSIONS

Thursday & Friday (Overlaps Conference)

Sessions:
TST-1, TST-4, TSF-1, TSF-4:

"CD-ROM Encyclopedias What Do We Want Our Children To Do With Them?"

Presenter:
Terrill Soules, Microsoft Educational Sales Representative

Discuss the answer to this question in this technical session from a number of perspectives, using Microsoft's new CD-ROM Encyclopedia Encarta as an example. Watch simulations of the child at play, the child answering one question, the child doing research for a paper and then incorporating that research into a word processor.

Other discussion points will include levels of knowledge, the role of sound, color, and animation; and a comparison of how several print encyclopedias and several CD-ROM encyclopedias, including ones not by Microsoft, cover a given topic.

Then, take a look at Microsoft's other multimedia programs—Bookshelf (a set of references), Instruments of the World, Cinemania (movie information, including stills and sound clips), and others.

Review Microsoft's new multimedia development tool, Multimedia Viewer Publishing Toolkit, version 2.0 for Windows. Viewer offers software creators who may not know a programming language a combination of hypertext, search and retrieval procedures, and the ability to incorporate graphics, video, and sound in the multimedia publication.

Sessions:
TST-2, TST-5, TSF-2, TSF-5

"OS/2 2.1 - The Multimedia Platform of Choice"

Presenter:
Jeff Howard - OS/2 Marketing Program Manager-IBM United States

OS/2 2.1, the newest release of the 32-bit operating system from IBM, provides a wealth of capabilities. Besides the abilities to run DOS, Windows 3.1 Standard and Enhanced mode, and OS/2 applications, OS/2 2.1 includes Multimedia Presentation Manager/2. MMPM/2 includes the latest software motion video technology in IBM's Ultimotion and Intel's Indeo. Mr. Howard will discuss how OS/2's 32-bit flat memory model, preemptive multitasking and standard multimedia capabilities make it the platform of choice for multimedia development.

Sessions:
TST-3, TST-6, TSF-3, TSF-6

"A Focused Overview of EdLAN, ICLAS and LANSchool"

Presenters:
Karen Eddy - Connecting Point-Computer Source
Phyllis David - IBM EIS

IBM Education LAN and Tools is an educational network package which consists of network management software, productivity tools and related publications.

It includes the IBM Classroom LAN Administration System (ICLAS), Novell Advanced Netware, IBM LinkWay, Microsoft works, LANSchool, Excelsior Grade and Quiz and Express Publisher.

If you qualify for the new BusEd PAK, the following programs are included: Work Perfect 5.1, Lotus 123, Southwestern Accounting, and the Ainsworth Keyboard and Keypad Trainer.

CONCURRENT SESSIONS

Concurrent Sessions

Thursday Sessions

Beginning 9:45 am

Session T-1:
Multimedia: A New Vision For The Classroom
Speaker: Patricia A. Bergeron, Champlain College Academic Computing
Level: All
Challenge the 90s student with multidimensional interests and abilities with multimedia in the classroom.

Session T-2:
Integrating Technology (Multimedia) Into The Classrooms At Utah Valley Community College: A Unique Approach
Speakers: Ralph T. Merrill, James E. Barnes, Dennis A. Fairclough, Utah Valley Community College
Level: All
Review Utah Valley Community College's integration of multimedia, including why a new Teaching/Learning Center of Excellence was formed.

Session T-3:
Enhancing The Curriculum Through The Internet
Speaker: Catherine M. Townsend, Rural Education Alliance for Collaborative Humanities
Level: Intermediate, Advanced
Consider how Internet can enhance leaning by allowing students to research, compile, and share with others around the world their own local culture and history.

Session T-4:
Electronic Presentations, Video Editing, Multimedia? What is it?
Speaker: Marlene Augustine, Lanier Presentation Systems
Level: Beginning
Creating electronic presentations using full motion video and sound with VideoShow.

Session T-5:
Specification of a Pan-European Integrated Multimedia Service (IMS1)
Speakers: Martijn Hoogeveen, PTT Research, Netherlands; Christian Bertin, France Telecom/CCETT, Jerker Andersson, Infologics, Sweden; Simon Jones, Ph.D., British Telecom
Level:Intermediate
View a sample of a pan-European multimedia service demonstrated by a real estate application, a video encyclopedia, and a tour operator application.
(90 minutes)

Session T-6:
Visualizing Spatial Relationships: A Multimedia Training Environment
Speakers: Trish Russo and Lyn Mowafy, University of Dayton Research Institute
Level: All
Preview a fighter pilot training program of the future using multimedia to simulate a three-dimensional world in which pilots can learn on the ground.

Beginning 10:45 am

Session T-7:
Making DVI Work: Problems and Solutions
Speaker: Stephanie Low Chenault, College of Charleston Computer Science Department
Level: Beginning, Intermediate
Survey various DVI (digital video interactive) authoring systems and software and a variety of hardware options to make portable presentations.

Session T-8:
Using The Computer Algebra System MAPLE V In The Classroom
Speaker: Herbert Brown, The University At Albany Mathematics Department
Level: All
Transform your undergraduate mathematics classes with MAPLE V software that allows both students and faculty unprecedented access to numerical, symbolical, and graphical tools.

Session T-9:
Interactive Multimedia On CD As A Tool For Higher Education In The UK
Speakers: Terry King, Roger Beresford, University of Portsmouth, Milton Campus Department of Information Science
Level: Beginning, Intermediate
Address different modes of learning in higher education in the U.K. and the impact of specific software on the learning outcomes.

Session T-10:
Educational Technology At The University of Notre Dame:Supporting Faculty Development
Speakers: C. Joseph Williams, Thomas C. Laughner, University of Notre Dame
Level: Beginning, Intermediate
Learn about Notre Dame's development of computer and multimedia educational technologies, its capabilities, the support effort for faculty development, and examples of faculty projects.

Session T-12:
Multimedia In A Third-World Nation
Speakers: Carlos F. Lam, Ph.D., Beryl C. Martinson, Ph.D., Panama Canal College, Victor Barragan, Ph.D., Universidad de Panama
Level: All
Discuss the potential for and barriers to increased use of multimedia technologies in Central America and other similar regions of the world.

Beginning 1:45 pm

Session T-13:
Creating Practical Multimedia Presentations
Speaker: Emilio Ramos, Richland College Business Division
Level: Beginning, Intermediate
See the multimedia authoring system created and used by educators in Dallas County Community College District that incorporate use of text, graphics, sound, animation, and digital video.

Session T-14:
"KB-ITS: A Knowledge-Based Intelligent Tutoring System
Speaker: Pervez Ahmed, King Saud University College of Computer and Information Science
Level: Beginning, Intermediate
Discover the use of an Intelligent Shell that evolves, learns new concepts, and makes important assertions about the subject being taught.

Session T-15:
Instructional Integration—Multimedia In The Classroom
Speakers: Dr. Carl Koenig, David Curtis, Mike Palmer, Maple Woods Community College
Level: Beginning, Intermediate
Evaluate the results of a one-year study on incorporating multimedia technology into junior high, senior high, and community college classrooms.

Session T-16:
A Simulation Of A Rocky Intertidal Zone Of The Pacific Northwest
Speaker: Dr. Raymond Russo, Indiana University - Purdue University at Indianapolis Biology Department
Level: All
Challenge biology students with multimedia simulations to allow the student to "visit" an exotic habitat and to teach the process of experimental design by success resolutions.

Session T-17:
SIMPORT: A Decision Simulation Training Package For PC
Speakers: Dr. Edna Hession, Paul Tallon, University College Business Administration, Dublin Ireland
Level: All
Experience a group exercise in decision making on capacity, technology, and equipment suppliers, as would arise in a typical small-scale investment project.

Session T-18:
VBI Technology Used To Combat Unemployment In South Carolina
Speakers: John Watson, South Carolina Employment Security Commission, Ruth Marshall, South Carolina Educational Television
Level: All
Discover how South Carolina combats unemployment using multimedia and television airwaves to disseminate 7,000 job openings to locations across the state to be displayed or printed out.

Beginning 2:45 pm

Session T-19:
A Practical Guide To Integrating Multimedia Into Higher Education
Speaker: Mary Jac M. Reed, The Catholic University of America Academic Computer Services
Level: Beginning
Support the introduction of multimedia to higher education with proven techniques including glitzy introductions, seed projects, skilled project management, and a lot of cheerleading.

Session T-20:
Multimedia For Education and Business
Speaker: Carl W. Helms and Phil Quist, Clemson University Educational Information Technology Laboratory
Level: All
See how Clemson's *InteractiVision* authoring environment can help teachers prepare lecture-support materials and help businessess with marketing and training.

Session T-21:
Micro Marketing: Multimedia CourseWare For Business Students
Speaker: Rick Webb, Johnson County Community College
Level: Beginning
Explore courseware the brings outside world experience into the classroom for marketing students developing product marketing plans.

Session T-22:
Planning Multimedia For Multiple Goals
Speaker: Eric Wignall, Valparaiso University Instructional Media Center
Level: All
Learn how to reach a culturally-diverse audience through multimedia more effectively by applying the same process that has been refined in the print and electronic media for over 400 years.

Session T-23:
Building Large Hypermedia Systems Using Object-Oriented Principles
Speakers: Alicia Diaz, Silvia Gordillo, Gustavo Rossi, Mariano Bibb, Universidad Nacional de La Plata, Argentina
Level: Intermediate
Explore using an object-oriented model for authoring hypermedia systems, describing conceptual relationships between nodes and creation of templates defining nodes' appearance.

Session T-24:
Keeping "In-Touch" With Your College Community
Speakers: Ginger Toth, Debra Watson, Monroe Community College
Level: Beginning
See how Monroe Community College delivers more up-to-date information to students through five strategically-located kiosks using touch display screens.

Beginning 3:45 pm

Session T-25:
Educational Effects Of The Classroom Presentation Option
Speakers: Dr. Duane Moser, Dr. Janet Burke, Dr. Josephine Hamer, Dr. Laurel Halloran, Western Connecticut State University
Level: All
Assess the value of the Classroom Presentation Option (CPO) which uses classroom keypads designed to promote interaction with students and feedback to the instructor.

Session T-26:
MediaLink: A New Method For Authoring Multimedia Lessons For The Classroom
Speaker: Robert L. Oakman, Jay A. Waller, and Fred Fenimore, University of South Carolina Department of Computer Science
Level: Beginning
Learn to easily assemble a multimedia lesson plan without the heavy learning curve of much authoring software using *MediaLink* for Macintosh.

Session T-27:
Basic CAI Tutorial Design
Speaker: Michael E. Petty, Indiana Vocational Technical College-Southwest
Level: Beginning to Advanced
Determine the most effective structure for computer-assisted instructional design while incorporating presentation, drill-practice, games, and simulations.

Session T-28:
The Art Of Being Human - The Wonder Of Form
Speakers: Thelma Altshuler, John Villamil, Miami-Dade Community College, Wolfson Campus
Level: All
Watch an interactive laser disc program that allows students to learn more about Plato's theory of form, the essential form, and the difference between classicism and modernism.

Session T-29:
Multimedia User Interface Design For Computer-Based Training
Speakers: J. Morgan Morris, G. Scott Owen, Martin D. Fraser, Georgia State University Department of Mathematics and Computer Science
Level: All
Focus on a design methodology identifying appropriate uses of computers, videos, print and audio technologies for computer-based training.

Session T-30:
From Hypertext To Hypermedia
Speakers: Wilma Strang, Hassan Khan, Dave Slater, Vicki Simpson, University of Kent Hypertext Support Unit, Canterbury England
Level: All
Explore pro-active strategies to support teaching staff support in moving from a text-based environment to one which fully exploits the available technology.

Friday Sessions

Beginning 9:45 am

Session F-1:
Using COMPEL To Create Stunning Multimedia Presentations
Speaker: Lorinda L. Brader, East Carolina University Academic Computing
Level: All
Be the first to view COMPEL, a brand new full-featured graphics presentation product released by Asymetrix, the producers of ToolBook, that uses text, graphics, sound, animation, full-motion video overlays or digital video.

Session F-2:
Development and Evaluation Of A Hypertext-Based Multimedia Tutorial For Use In New Employee Orientation
Speaker: April D. Snyder, Clemson University Department of Psychology
Level: Beginning
Assume more personal control of content using multimedia as new employee orientation rather than traditional videotape.

Session F-3:
Cyberteaching: Teaching About And Within Cyberspace
Speakers: Glenn Cartwright and Marcos Silva, McGill University
Level: All
Explore this imaginary, computer-mediated, three-dimensional space and how to better plan our time, improve our navigation, and understand the concepts we learn there.
(90 minutes)

Session F-4:
Technologically-Assisted Focussing—A Breakthrough For Clinicians, Teachers, and Researchers
Speaker: Den' Raphaely
Level: All
Explore the use of computer-controlled video in psychotherapy to give immediate feedback on interaction as well as cross-reference video records from other sessions.

Sessions F-5:
Multisite Multimedia Courses
Speaker: William Perrizo, North Dakota State University Computer Science Department
Level: All
Clone expert teachers and expensive equipment in advanced subjects by using multimedia courses simultaneously delivered to students at several sites.

Session F-6:
Total Quality Instructional Design: Integrating Instructional Design and TQM
Speakers: James Corvey and Larry Legg, Mountain View College
Level: Intermediate
Relate the common elements in instructional design and total quality management by viewing interactive instructional programs in biology, English, business, and English as a second language.

Beginning 10:45 am

Session F-7:
Using Multimedia with Large Lecture Sections: Does It Work?
Speakers: Dr. Arnold J. Karpoff, Dr. Carolyn Rude-Parkins, University of Louisville
Level: Beginning, Intermediate, and Advanced
Evaluate the success of using multimedia in large lecture sections by student perceptions as well as by numbers.

Session F-8:
A Curriculum To Teach Database Development and Retrieval of Multimedia Documents
Speaker: Arie Noordzij, The Hague Polytechnic, Netherlands
Level: All
Review a curriculum for library and information studies on the development of databases for the storage and retrieval of multimedia documents.

Session F-10:
Multimedia For Speaker Support: Issues In Design, Programming, Synchronization And Media Integration
Speakers: Jon Gorrono and Ken Weiss, University of California, Davis
Level: Beginning, Intermediate
Discuss how the application of multimedia to speaker support in a live presentation environment differs from normal uses and the special problems it imposes.

Session F-11:
Introducing Multimedia Applications Into The Curriculum Using IBM Technology
Speakers: Brian G. Scarbeau, Glenn A. Ricci, Rebecca C. Thornton, Lake-Sumter Community College
Level: All
Learn how Lake-Sumter Community College will implement multimedia applications into the curriculum.

Session F-12:
Multimedia On A Shoestring
Speaker: Michael J. Payne, Purdue University Department of Computer Technology
Level: Beginning
Develop multimedia projects on a very small budget using existing hardware and software.

Beginning 1:45 pm

Session F-13:
Teaching Physical Skills Using DVI and DataGlove Technology
Speaker: Janet L. Hazard, Syracuse University Sue Ann Genet Gallery
Level: All
Learn how complex and precise physical skills are taught using DVI and DataGlove technology, effectively "cloning" the instructor to be available 24 hours a day.

Session F-14:
Developing A Multimedia Laboratory
Speakers: B.J. Gleason, Anita La Salle, Gene McGuire, The American University Computer Science and Information Systems
Level: Beginner
Follow the design of a multimedia laboratory that supports the creation of faculty and student-designed curricula for a university.

Session F-15:
Repurposing Multimedia: Reciprocal Uses of Multimedia and VHS
Speakers: Kent Roberson and Jerry Zink, Oklahoma State University, Okmulgee
Level: Beginning, Intermediate
Examine repurposing multimedia, using various programs and multimedia equipment as production tools to create products that do not involve multimedia equipment for display.

Session F-16:
Incorporating Sound, Laser Disc, and Scanned Pictures into Hypercard
Speaker: Diana Gearhart and Carole Hruskocy, Nathan Hale Elementary
Level: Beginning, Intermediate
Learn how two teachers use hypermedia to get students excited about learning in language arts, science, and social studies.

Session F-17:
Interactive Videodisc Technology in Medical Education
Speaker: Thomas Singarella, Ph.D., University of Tennessee, Memphis, Health Sciences Library and Education Center
Level: Beginning, Intermediate
Discover how videodisc technology is being used in medical education throughout North America.

Session F-18:
Student Developers: Learning Through Creating Multimedia Term Papers
Speaker: Patricia S. Fox, Trident Technical College Information Systems
Level: All
Explore strategies and methods used to guide students through the development of multimedia term papers.

Beginning 2:45 pm

Session F-19:
Film Studies, Intertextuality, and Interactivity: A Computer Model For Cinema Studies
Speaker: Robert P. Kolker, University of Maryland English Department
Level: All
Observe how ToolBook and Video for Windows uses laser disc access and .AVI files to demonstrate thematic, narrational, and formal devices in film structure.
(90 minutes)

Session F-20:
The Classroom Of The Future
Speaker: Clifford L. Whitehouse, Department of Defense Transportation School
Level: All
Examine the design of a state-of-the-art classroom using satellite television hookup, CD ROM, networking, video projection, and virtual reality.

Session F-21:
Networked Virtual Reality
Speaker: Carl Eugene Loeffler, Carnegie Mellon University College of Fine Arts
Level: All
Discover virtual reality, how it can be networked, and how it can be used in cultural, creative arts, and educational applications.

Session F-22:
The Integrated Biochemistry Learning Series (IBLS): A Learner Controlled, Multimedia Program for Medical Biochemistry
Speakers: Sharon E. Dennis, M.S., University of Utah and James Baggott, Ph.D., Hahnemann University
Level: All
View a comprehensive medial biochemistry instructional program for Macintosh that improves learning effectiveness and efficiency.

Session F-23:
Developing An Interactive Tutorial Using ToolBook: Some Problems and Solutions
Speaker: Rajir Malkan, Lamar University at Orange
Level: Beginning, Intermediate
Consider the proper design techniques for creating tutorials using Toolbook including shortcuts and solutions to problems encountered.

Session F-24:
Utilizing Multimedia Techniques In Introductory Management Information Systems Courses
Speakers: Dr. Leah R. Pietron, Dr. Dwight A. Haworth, University of Nebraska-Omaha Information Systems/Quantitative Analysis
Level: Beginning
Examine the performance of different multimedia techniques in teaching beginning MIS courses, their design, authoring tools, and presentation.

Beginning 3:45 pm

Session F-26:
Developing An Interactive Database On A Shoestring Budget
Speaker: Patricia Baker, State University of New York at Stony Brook School of Continuing Education
Level: Beginning
Empower staff with access to decision-making information using easy-on-the-budget software such as FileMaker Pro 2.0.

Session F-27:
Critical Thinking In The Multimedia, Self-Paced English Classroom
Speaker: Lee Ann Mortensen, M.F.A., Utah Valley Community College English Department
Level: Beginning, Intermediate
Foster critical thinking in a multimedia, self-paced English classroom through high-tech writing and reading using electronic mail, Freelance Graphics and Multimedia Toolbook.

Session F-28:
Meeting The Challenge: Creating Multimedia To Teach Critical Thinking Skills
Speaker: Sharon B. Colton, MED, University of Louisville Instructional Technology
Level: Intermediate (but useful to beginner and advanced)
Follow instructional development of a critical thinking skills course from script writing and casting, through video production, through computer software choice and authoring, to student e-mail for collaboration, and listserv setup.

Session F-29:
Business Application For The Dissemination Of Electronic Information
Speakers: Jeffrey Bradley & Murray Wilson, Multisolutions, Inc.
Level: Intermediate
Access the information you need easily and fast with a user-friendly, highly-interactive Windows delivery system.

Session F-30:
How Much Is Enough? Choosing A Computer-Based Video Technology
Speaker: Michael Pearce, Galaxy Scientific Corporation
Level: Intermediate
Survey several technologies for capturing and displaying video on desktop computers to include in computer-based training and job aiding systems.

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