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Electronic Teaching and Learning: Trends in Adapting to Hypertext, Hypermedia, and Networks in Higher Education

by

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Chapter 6
The Paradigm Shift in Technology and Learning:
Teaching Will Never Be the Same

On May 13, 1994 in London, a special issue called Synthesis: The Times Higher Education Supplement devoted the entire issue to trends, advantages, and disadvantages of multimedia for teaching and learning. Several quotations from that issue are as follows:

This (traditional school education) is the beginning of an epistemological shift that will culminate in learning by being taught. Since the children cannot follow their own interests in pursuit of knowledge, school takes responsibility and the paraphernalia of fragmentation of knowledge, linear curriculum, segmentation by age and the rest follows as the .... But given an increasing difficulty of imposing the curriculum on the children it seems quite likely that school will find an escape by opening itself to what would already be obvious if the education establishment had an open mind ... Papert (1994, p. 2)

Multimedia is different again, and more complex to understand because it is not a narrative medium. The user control it offers in the form of interaction with the information it presents changes the role of the audience. In fact, multimedia does not really have an audience; it has participants. The participants do not sit back and enjoy the story; they help to create it. That radical change in the nature of the medium means that it must take some time before we learn how best to use it. Laurillard (1994, p. 3)

Learning will take place at the computer screen and from the book, and the computer will take as much a part in organising the learning and in computing, as it does in delivering the information. The point is that the computer is providing a stimulus for change in the system, and is recasting undergraduate materials in a manner which can help cope with the pressures faced. Beilby (1994, p. 11)

Frustrations of Hypermedia Authors

There are many frustrations that professors who venture into hypermedia authoring, teaching and research must be prepared to encounter. Some of these were discussed in Jensen and Sandlin (1992a, 1992b), Jensen (1993), Solomon (1994), Tropea and Rothermel (1994), and Sammons (1994). A more complete listing is given below:

1. College reward systems seldom recognize the degree of creativity, learning time, and authoring time required for development of hypermedia materials. This is not yet the area of endeavor for success in raises, promotions, and tenure. Times are changing in reward structures, but faculty who presently sacrifice research and service performance in order to develop learning materials probably are at risk in the system.

2. Commercial reward systems (for authors and publishers) for hypermedia authoring are not yet established to the extent of, say, hard copy textbook authoring. Publishers cannot find ways to make as much profit by getting away from hard copy and are especially resistant to networking and the information highway. Issues are complex and debates
are heated. A nice review of the problem of "remaking scholarly publishing" is provided by DeLoughry (1993c).

3. Lack of standardization of hardware and software can be very frustrating. For example, Mac CD-ROMs will not run on PC CD-ROM players and vice versa. (unless hybrid formatting us used that may have unwanted side effects described in New Media, August 1993, p. 94). MPEG video compression is probably the best technology, but most PC owners do not have the necessary hardware. Beware of vendors who claim that materials can be transported from one platform to another. For example, Authorware has a utility for translating files authored on a Mac into Windows files but not vice versa. Moreover, some things do not translate well from Mac to Windows, particularly high resolution color graphics, animations, and full motion video. Even on the newer and more powerful platforms such as the Apple/IBM joint venture Power PCs, Windows NT, and Unix there will be incompatibilities and technology changes that make it impossible for one set of authored lessons to be all things on all platforms. Some newer software packages such as ScriptX from Kaleida Labs are designed to run on "cross-platform" multiple operating systems, but this will not overcome the problems of translating graphics and animations between certain types of hardware such as translating a 24-bit color graphic for an 8-bit color display.

4. Most networks on college campuses are not capable of doing all the things that you would like to author into your lessons (e.g., showing networked segments of videotapes, playing networked CD-ROMs, transmitting high resolution graphics over long distances, etc.).

5. Lessons authored on your desktop PC may not deliver as well on classroom computers of laptop computers. For example, if your desktop has high resolution PC, graphics images and full motion video files may turn into a mess on lower resolution computers such as those than will only run standard VGA. Images authored on large monitors may appear trimmed on smaller monitors (this is especially a problem for Mac users). Animation and audio timings may go out of synchronization. You can avoid this by authoring in standard VGA resolutions, but then the images may be very unsuited and/or unprofessional in appearance. Other frustrating differences between authoring and delivery computers include differences in RAM, differences in buses (delivery machines may not have local busses), hard drive capacity, SCSI incompatibilities, etc.

6. The choice of authoring software can be crucial. One of the authors (Jensen) devoted three years to authoring of accounting courses in HyperGraphics only to discover that the software vendor is not keeping this authoring alternative up with the times in terms of hypermedia authoring and importing of large text blocks. This forced him to shift from HyperGraphics to Multimedia ToolBook midstream after developing hundreds of hours of student learning materials in HyperGraphics. There are many other examples of authoring frustrations. Educators who used SuperCard, Hyperties, and Owl's Guide early on now find these products no longer supported at all by the software vendors. Authors of materials in Tencore are frustrated by having to remain in DOS (even though DOS programs will run under Windows, they are not the same as running programs that can use the many wonderful Windows utilities). Many software vendors such as Allen Corporation (Quest software) promised Windows upgrades, but then took several years to deliver on their promise. Virtually every analyst predicts that the large number of hypertext/hypermedia authoring alternatives listed in Chapter 3 and Appendix 6 cannot all survive as the market sorts itself out in the rest of this decade. There are just too many alternatives at present in this market. Educators making crucial choices of authoring software should be very careful to examine their long-term goals and objectives and then seek expert advice from other educators before making a "final" choice. It can be very risky to seek only the advice of the software vendors, because they are obviously biased
in favor of their own products. Guglielmo (1993, p. 51) predicts that “authoring tools will be hot sellers, though the jury is still out on whether there's a big market for low-end solutions.” A tremendous frustration will be for faculty to sink a lot of learning time and/or production time into an authoring system that falters. Authors who initially thought runtime/royalty fees would not be important may later discover that they made a frustrating choice of authoring software when they decide to author commercial books. This problem is discussed below.

7. Some software packages have better graphics and text filters than other packages. The package you select may not be able to import some types of files that you want to put into your lessons. For example, a hypermedia authoring software often will not import all JPEG, TIFF, PCX, BMP, TARGA, and the many other file formats for graphics images. Most hypermedia authoring packages will not import directly from word processors without losing many of the formatting, color, font variations, etc. in the original versions. This is extremely frustrating for authors who have much of their work already typed into word processing files (e.g., Word Perfect, Word for Windows, and Word Star) and want to convert it into hypertext or hypermedia without having to convert the text to an ASCII format and then reset all the fonts, formats, etc.

8. Hypermedia packages are not full-featured word processors, graphics processors, and spreadsheet processors. The many and varied features taken for granted in other packages are sorely missed when authoring hypermedia lessons.

9. Authoring workstations may require expensive auxiliary support for some types of materials to be authored. Possible support equipment includes external hard drives, computer tape drives, flatbed scanners, videodisc players, CD-ROM recorders, scan converters to transform computer images onto videotape, professional VCRs, professional video cameras, multiple monitors, etc. For more complex CD-I authoring specialized software (e.g., MediaMogul) and hardware (e.g., an emulator) are both required. Hardware for compressing full-motion video can also be expensive.

10. Since some types of hypermedia authoring can be a slow process, even professors who have the necessary technical skills to do their own work will probably still want technically trained assistants. Students may not have these specialized skills and faculty may have a difficult time raising support money needed for professional technicians.

11. Disruptions in student usage of campus networks, computer labs, and other computers can raise havoc in your courses if you did not allow for such disruptions with backup plans and allowances. Computers shared by students are particularly vulnerable to computer viruses and physical abuses. To be on the safe side, it is best to have some contingency plans for yourself and your students. For example, if you normally teach in an electronic classroom from a computer linked to the campus network, it is best to have a laptop computer or other reserve computer in case the network fails. It is best to have a reserve LCD panel in case a three-beam projector malfunctions. Try to schedule your student workloads so that they have heavier computing assignments in slack periods and lighter assignments when students from other courses are likely to queue up at workstations.

12. Projection hardware such as three-beam projectors and LCD panels may not work well with lessons authored in resolutions higher than standard VGA. If the computer is cut back to standard VGA resolution, graphics and videos may become lousy. Newer panels costing over $8,000 will probably run full motion video at resolutions higher than standard VGA. However, the entire screen appearing on the monitor may only appear partially on the projected image of the LCD panel. Thus, it may be necessary to scroll the panel
images to see the full screen. Our experience with this is that scrolling is very awkward and distracting for audiences.

13. State-of-the-art technology for authoring is generally years ahead of the consumer/user market. For example, CD-ROM discs (that allow authors to permanently store 680 Mb of data on a 5-inch laser disc) have become very popular even though they are not well suited for storing large amounts of full-motion video. Type four laserdiscs are better suited to interactive video, but now that millions of potential customers worldwide have CD-ROM players and very few have type four laserdisc players, authors must consider the technology of the market place. If jukeboxes of stacked CD-ROM players become as popular as single-drive CD-ROM players, then commercial authors will have to consider placing compressed full-motion video on multiple CD-ROM discs instead of laserdiscs. MPEG compression is better than most other forms of video compression, but not many potential customers have the hardware to view MPEG-compressed video. The point here is that electronic books with interactive video are wonderful inventions, but the potential market for the best works may be very small due to technology lags of the customer base. Tropea and Romerthel (1994, p. 85) complain about storage limitations of CD-ROM discs and propose that plug and play hard discs become more of a standard in education.

14. Authors typically have more capacity/power in their authoring computer systems than users (students, customers, etc.) have in their applications systems. For example, an author may have over 100 Mb of RAM and 2 Mb of video RAM. A user may have less than 8 Mb of RAM and 1 Mb of video RAM. Authoring for the "market" may greatly under utilize the quality of multimedia authoring than can be accomplished on the authoring system. For example, high quality graphics and video may have to be compromised in order to make the learning materials usable by stunts and/or customers.

15. Because academic authors have become accustomed to citing ideas and short quotations from academic literature without always formally obtaining written permission for short quotations, it is tempting to carry this practice over into hypertext/hypermedia authoring. In the past, scholarly publications tended to cite and insert short quotations without formally obtaining written permission for each quotation. There is more legal risk in continuing this practice today. And yet, it is terribly inconvenient to have to obtain permission for each item quoted and possibly even dysfunctional if the inconvenience and delays lead to more paraphrasing of ideas without formal citations and original quotations. Also there is a tendency to photocopy (without permission) longer portions of the literature for use by students on a nonprofit basis. Carrying such practices into hypertext/hypermedia authoring may be unethical or illegal in many instances even if works are cited and no profits are involved. For a summary of the dangers in copyright infringements, see Rodarmor (1993). Zimmerman 1994) discusses record company policies with respect to music clip inserts into multimedia. Most charge royalties of three to nine cents on each item (e.g., disc) reproduced (not necessarily sold) unless the clips are taken from "royalty free" music byte files or copyrights have expired. Copyrights on music and video, however, extend much longer into time than patent rights. Network and satellite broadcasting delivery of learning materials create special problems discussed in Switzer and Switzer (1994). For example, do rights to a single copy of a video clip, a music clip, a text segment, a published paper, etc. carry over to presentation to a "class" of students that are geographically dispersed across 50 states and foreign countries? Is there a legal difference between a class assembled in Room 214 on campus and a class assembled in front of geographically dispersed computers? The use of audiovisual works by a non-profit educational institution are governed by the fair use guidelines, including the 1976 Copyright Act Section 110 that sets guidelines for use of copyrighted works. Section 110 extends those guidelines to retransmissions. There are clearly
defined exemptions of copyrights for classroom presentations and retransmissions, but how does this apply to materials on databases that are available online at various time continuums and widely dispersed "students?" The bottom line conclusion of Switzer and Switzer is the the 1976 Copyright Act should be revised and clarified in light of the technologies involved in education today. For now, copyright issues in distance learning remain a gray area." Clearly, legislators and courts dance on a fine line between responsibilities for stimulating creativity and stimulating learning.

Opinions of Some Leading Educators

The remainder of this chapter consists of Professor Jensen's description of a Trinity University seminar (FSS 01) for campus-wide faculty. Opinions of off-campus leaders invited to participate in that seminar are highlighted.

In Spring Semester 1992, Trinity University awarded me a grant to conduct a campus-wide 1992 Faculty Summer Seminar (FSS 01) that other universities may want to emulate. This portion of the book will be devoted to summarizing some of the findings in this seminar. With three other Trinity faculty members assisting me in leadership roles, we conducted FSS 01 with 21 faculty participants competitively selected from departments across campus. Eleven leading-edge consultants in education technology from outside the campus also participated in this seminar. Small portions of what follows are reprinted from Jensen (1993).

The general conclusion among leaders and participants in this seminar was that education is in the midst of a monumental technological paradigm shift that will change the way that virtually all instructors teach and the way that virtually all students learn. Many of us are at our best when we are explaining technical concepts, theories, techniques, procedures, and processes. At this juncture, however, traditional teaching roles are going to change. One of the most interesting servers for technology in education is the MIT university “MIT EVAT Report-Models for the Future” at <http://www-evat.mit.edu/report/>.

Continued belief that traditional classroom approaches will beat emerging generations of teaching machines in explaining technical knowledge is a cherished myth [Appendix 18, Winter (9)]. Experts on the leading-edge of technology and learning theory tell of a rumbling paradigm shift that will soon hit education at about 9.8 on the Richter scale. Predicting when and how hard it will hit each instructor in each school is about as difficult as predicting earthquakes, but there is little doubt among leading-edge researchers and scholars that technological plates are rumbling in an extraordinary paradigm shift.

Hypermedia learning entails interactive and nonlinear navigation through learning material that reaches students by various sensory stimuli (seeing, hearing, touching, smelling). Hypermedia computers connected by international broad band networks will do most of the "interactive teaching," especially teaching of technical details of art, business, history, languages, mathematics, medicine, music, science, etc. Instructors will do less explaining, because the best materials of the world's best teachers on almost every subject: (i) will be added to the instructor's own hypermedia presentations, and (ii) will be available on call every day at any time of day the student wants to learn. Educators' new roles will be as follows:

1. Course instructors will play a greater role in inspiring students to want to learn more about a subject and a lesser role in explaining that subject to students.

2. Course instructors will spend more time authoring hypermedia materials to be made available at all hours of every day on campus networks.
3. Course instructors will play a much greater role selecting learning goals and helping students choose from a mind-boggling multimedia library of worldwide learning material that will build at an exponential rate in the next century.

4. Some instructors will build international reputations for creativity in authoring and continually updating hypermedia learning materials made available on vast worldwide education networks, [Appendix 18, Graves (5)].

1992 Faculty Summer Seminar at Trinity University

FSS 01 was comprised of plenary sessions each morning and workshops each afternoon for 13 consecutive work days. In addition to myself, other Trinity University educators who served as group leaders were Professor Robert Blystone (Biology), Professor Glenn Kroeger (Geology), and Professor Suzanne Williams (Communications). They were exceedingly valuable in helping design the program, inviting outside speakers, making their own plenary session presentations, and leading three of the four daily workshops. The participants are especially grateful to the outside speakers who agreed to come to campus at less than their usual consulting fees and the Trinity faculty who applied for the program and gave up part of their summer for the cause. We are also grateful to the team of consultants who conducted an on-site workshop one afternoon at Southwest Research Institute in San Antonio. Among other things, this off-campus visitation allowed all of the seminar participants to slip on virtual reality (VR) headgear and enter the three-dimensional simulation worlds of VR.

Although a few participants were already authoring hypermedia teaching materials, others in the group had virtually no computer experience of any kind. Two of them could not even type. Some were initially enthusiastic about the prospects of education technology. Others ranged from mildly to deeply skeptical. Prior to the seminar, participants were given tours of various facilities on campus, including a tour of the facilities such as the radio station, video studio, and Amiga Computer workstation at our Richardson Communication Center on campus, the facilities in our Instructional Media Services, the electronic classrooms on our campus, the facilities in the Computer Services Center, the facilities in the Biology Imaging Laboratory, and facilities in the Computer Services Center. As a result of demonstrations on each of these tours, all seminar participants had a basic awareness of electronic classroom multimedia computing facilities, campus networks, and international networks on the Internet.

The leading-edge consultants who conducted morning plenary sessions are listed in the Appendix 18 of this paper. Appendix 18 also lists some points made by those speakers. The points listed are from my notes and my excerpts edited a FSS 01 Highlights videotape; Appendix 19. The points listed under each consultant in Appendix 18 were selected to dovetail into the theme of this paper. They are not necessarily the major points, or even outline headings, that the speakers themselves might choose if I had asked them to list the major points in their presentation. I pieced together excerpts from nearly 50 hours of videotape into the FSS 01 Highlights videotape that runs for nearly four hours. Readers may obtain copies of this tape by following instructions given in Appendix 18I of this paper.

Trinity faculty participants each worked on both individual and team (task force) projects in workshops. They presented their multimedia results to the entire group on June 3. Titles of the faculty multimedia projects are shown in Appendix 20. Half the participants learned how to author lessons in Multimedia ToolBook and how to customize videos on an Amiga Computer Video Toaster. The other half learned how to author lessons in HyperCard, QuickTime, and videos generated by MAC computers. All June 3 workshop presentations were videotaped and are available, along with plenary session videotapes, to all Trinity faculty, staff, and students. Several selected projects were also presented, along with short demonstrations by the four seminar leaders, at the first campus-wide faculty meeting of Fall Semester.
Comparative Advantages of Emerging Technology

What follows is a combination of my own opinions and opinions voiced by some participants and outside consultants in our 1992 Faculty Summer Seminar. All participants would not unanimously agree with my conclusions. Based upon the extensive evaluations and letters from participants subsequent to the seminar, I think most of them agree with the predictions in this paper. In plain words, the new technology in the emerging paradigm shift is jolting us with comparative advantages significantly different from technology of past decades. The key factors [Appendix 18, Graves (2)] causing this shift are the joining of international broadband networks with newer and hypermedia authoring and delivery systems that will be more accessible in one way or another by virtually all faculty. Materials available to students will be quite different and styles of teaching and learning will change dramatically. This opinion was shared by all of the leading-edge experts listed in Appendix 18. Probably the most in-depth review of learning theory, perception, and emerging technology is provided by J. Wesley Regian [Appendix 18 and Appendix 21]. Some of the comparative advantages include the following:

1. Broad band electronic networks render less need for physical proximity of learners to learning materials, other students, and teachers. The computer can be in Texas, the learning materials can be in the Louvre, and an entire "classroom" of interacting learners can be comprised of students physically located in different nations. In the paradigm shift, we are discovering that multimedia networking replaces both advantageous and adverse ingredients of learning in physical proximity of teachers and students. Networking is, at times, superior for both educational and social interaction. Dick Cutler [Appendix 18, Cutler (5)] stresses how personas affected by shyness, fear, and low self esteem sometimes become different personas in social interactions void of physical contact. Beauty vs. beast physical appearance differences have less meaning in networks where beasts can become networked beauties and vice versa. Language or other communication barriers between "teacher" and student shrink in the presence of interactive choices as to language, extent of visualization, extent of reading versus audio, etc. Robert Winter [Appendix 18, Winter (12)] indicates that Pacific Rim students tend to soar much higher in music theory when hypermedia enables them to overcome English language barriers. Network socializing patterns may be less impacted by skin color, sex, language differences, national origin, physical handicaps, and many other factors present in physical interactions. Anonymous students using fictitious names are already socializing over long distances with network friends and acquaintances they never intend to meet face-to-face. According to Dick Cutler [Appendix 18, Cutler (3,10)], old concepts of "pen pals" and "short-wave buddies" are now being taken to new dimensions via multi-user dungeon networks (MUDs) which are used by students more than their professors at this point in time. Students are teaching and entertaining each other across long distances at this very moment (for example, see Germain 1993 and Hafner 1994). And network socializing, communicating, and educating are closer to the realities to be faced in the real world. Bruce Hahn [Appendix 18, Hahn (10)] asserts that professors have been much slower adapting to new technologies than people in industry. Government agencies, the military, business corporations, and other parts of society are well ahead of academia in multimedia development for training and communications. Students not familiar with network communicating, socializing, and training will be competitively disadvantaged. Bruce Hahn [Appendix 18, Hahn(6)] points out that multimedia presentations have been so effective in presenting expert witness testimony that the outcomes of court cases may hinge upon which side has the most effective multimedia show. The tremendous successes of multimedia presentations in jury learning indicates that multimedia also has tremendous comparative advantages in student learning.
2. Computers have infinite patience in teaching that entails drill and repetition, especially for students with differing skills and aptitudes. From mathematics to music to pilot training, human instructors run short of patience when some students need seemingly endless repetitions relative to the few who catch on the first time. Newer hypertext and hypermedia learning materials allow nonlinear interactions such that learners can seek different levels of entry and alternative methods of presentation; [Appendix 18, Winter (7)]. Students needing more illustrations, cases, and audio/visual aids are actively in control of their own learning paces (provided the learning materials are rich in providing such options).

3. Real world experience is not necessarily the best teacher nor a practical teacher. Studying the 3-D terrain of Mars by interactively walking on the planet's surface is feasible only in virtual reality simulations. The time needed to diagnose and treat patients for certain ailments may be impractical and dangerous, whereas medical students at the Pennsylvania School of Medicine can administer eye examinations to simulated patients in a multimedia setting that simulates both normal and disease conditions. Conditions can be varied and the learning experience can be repeated as often as necessary for an individual student. In the technology paradigm shift, J. Wesley Regian [Appendix 18, Winter (1)] contends that simulations and virtual realities are often better teachers than real world experience. Learners can be placed in virtual worlds thousands of years forward or backward in time. Dick Cutler [Appendix 18, Cutler (8)] shows how VR allows us to shift time and space in constructed realities. New multimedia technologies make these worlds amazingly close to realities of different times and different locales. Learners can be placed in virtual dangers that are out of the question for real world training and education. Science students can handle toxic and explosive materials in virtual labs. Astronomy students can embark on multimedia star treks. Simulations make it possible to visualize masses of data and relationships that are otherwise incomprehensible. Donna Cox [Appendix 18, Cox (4)] shows how visualizations help to make intuitive sense out of complex phenomena. Financial analysts in TIAA/CREF currently enter virtual reality worlds to better understand the bewildering complexes of real world data. Navy students can sail any day of the week through any type and level of virtual typhoon of their choosing. American pilots and tank commanders trained repeatedly in high tech virtual reality worlds before embarking on real world missions in the recent Gulf War. Medical students learn on virtual patients and practicing physicians prepare for difficult surgeries and radiation treatments on virtual patients prior to treating their real life counterparts. Although virtual reality most of its applications to date in training and entertainment, there are some applications in data analysis such as the use of VR to analyze international portfolio data in the TIAA/CREF Pension Funds. Winn (1984) contends VR will become a major part of university curricula. He cites evidence that VR is especially successful for learning disadvantaged and physically handicapped students.

4. Some teachers with high skills of recall often seem "smarter" than teachers who fumble among voluminous notes or stand awkwardly silent on issues understood in deep memory that will not surface due to unavailable queues. Some researchers and scholars build reputations due to skills in finding materials as opposed to analytical and creative contributions. Robert Winter [Appendix 18, Winter (4)] claims that the digitization of knowledge implicit in the emerging paradigm shift changes the nature of these phenomena. In class, both personal and public files can be searched in seconds across campus or international networks of vast databases. Teachers with better understanding may, thereby, surpass teachers who merely have faster recall. Researchers will have more equal access to materials and high speed database search tools. Reputations must then be built on scholarship and creativity as opposed to skills of finding source materials.

5. Emerging technologies enable professors both to create their own customized teaching materials and to update those materials daily. New editions of electronic books can be put on network at will. Robert Winter [Appendix 18, Winter (50)] notes that electronic books can be changed when and how an instructor chooses, including changes made directly in front of an audience.
Emerging technologies that digitize knowledge make it cheaper and easier to combine all, or portions of, documents from multiple sources into a single file or electronic book. These technologies are very worrisome in terms of copyright infringements, but new ways of rewarding creative scholarship may emerge such that copyrights and electronic reproductions go hand-in-hand. The "minefields" of copyright restrictions are reviewed in *NewMedia*, October 1993, pp. 54-56.

6. Emerging technologies lift experts as well as beginners to higher levels of understanding. Robert Winter [Appendix 18, Winter (9)] illustrates how hypermedia can lift music understanding to new levels previously unknown to scholars and even to composers of the piece being examined. Hypertext and hypermedia nonlinear navigation may add entirely new insights to understanding music, art, history, etc. Donna Cox [Appendix 18, Cox (3)] observes that scientists have long known that clever visualizations of data are essential to discovery of key phenomena in the data. Emerging technologies may make visualizations more efficient and effective than any technology of the past. Dennis Huston [Appendix 18, Huston (5)] contends that visualization is essential to understanding new dimensions of literature and drama.

7. Multimedia training and education may save millions of dollars due to a variety of factors. For example, compact discs that hold thousands of pages of text and graphics can be reproduced for about $2 per disc. Hard copy publishing, in contrast, is significantly more costly and more difficult to update. Electronic books can be authored and updated at will on rewriteable optical drives. Expensive costs of transporting and housing trainees can be reduced or avoided altogether with delivery of training via compact discs, teleconferencing, and computer networks. Accounting firms are moving toward distance training to save direct training costs plus the indirect costs of lost billing hours due to employee time taken in the logistics of being transported to training sites.

8. Traditional texts are expensive and bulky to store and transport relative to new portable compact disc players having flip-up color screens. These can be carried in brief cases along with a few discs holding millions of pages of text, graphics, and audio files. Networks make it possible to transfer thousands of pages of text and graphics to new locations in the blink of an eye. Hard copy books are difficult to search in comparison to electronic searches of computer files.

9. Emerging technologies offer new dimensions of combining full motion video, recorded audio files, animated graphics, etc. to text. Users have capabilities to change (zoom) image sizes and presentation sequences interactively. These technologies add realism to learning materials that are impossible to duplicate in traditional texts and overhead transparencies.

10. Emerging technologies enable instructors to be more creative in presenting our course materials. We become producers, directors, artists, writers, actors, camera operators, and choreographers and editors of our own multimedia productions.

11. William Norris [Appendix 18, Norris (2)] contends that emerging technologies will play a vital cost-effective way of making timely and interactive learning materials available to virtually all persons on earth --- young or old, rich or poor, healthy or handicapped, rural or urban, sinner or saint.

12. As noted by Twigg (1993, p. 35), "non-traditional students will constitute what is being called `the new majority' in American higher education." This expanding subset of older and part-time students who are not full-time resident students need more flexibility in access to learning and other library materials.

13. No teacher can be an expert in multiple disciplines or even all aspects of a given discipline. Hypertext and hypermedia learning materials enable teachers to bring learning materials from these areas of nonexpertise into a course. This facilitates the trend in college curricula toward interdisciplinary teaching.
14. Interactive learning technologies tend to increase cooperative learning with appropriate student projects. Beatty and Fissel (1993, p. 84) report the following about teaching on fiber-optic media networks:

During the three years of operation under review, teaching encompassed the creative use of video sources in support of traditional lecture format. As we moved into the fourth year of operation, learning became more cooperative and collaborative ...

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**Comparative Disadvantages of Emerging Technology**

1. A book is only as good as the print stream between its covers. Similarly, a hypermedia presentation is only as good as its bit stream in a computer file. Hypermedia authoring by accounting professors is almost nonexistent. DeLoughry (1993b) reports that, in a large survey, authorings of instructional software and other Computer-Aided Learning (CAL) materials for students were given "low priority" in virtually all other academic disciplines. In our viewpoint, the major reason is the low priority given in general to learning materials development and particularly to CAL materials development in tenure, promotion, and merit evaluations in colleges around the world. Lack of support facilities in faculty offices, classrooms, and student labs are also problematic. These points were made repeatedly by respondents to our own surveys of educators and publishers. Promotion, tenure, and merit rewards are driven mainly by creativity in research (provided a professor is dismissed or otherwise punished for inept teaching). If teaching superiority is rewarded, the teaching rewards hinge primarily upon high student evaluations and/or a campus reputation for caring for and attending to students on an individual basis. A lackluster researcher who devotes 50 hours a week developing and updating wonderfully creative hypermedia teaching materials is likely to come up on the short end of tenure, promotion, and merit raise rewards. The same cannot be said for a lackluster, though adequate, teacher who devotes 50 hours a week generating wonderfully creative research. Rewards for great teaching materials development flow mainly from outside royalties on successful textbooks. At present, however, publishing firms and other businesses have not yet figured out how to "publish" electronic materials and make profits from sales to students. Authors are more likely to be rewarded for writing successful hard copy texts rather than creative electronic wizardry. An example of what can be done in hypermedia is provided by the Voyager Company CD-ROM entitled "Who Built America?" This is a scholarly hypermedia account of US. history between 1876 and 1914. It provides an example of the type of hypermedia authoring that is needed in virtually all fields of academe.

2. Markets for hard copy books are well established. Libraries are equipped with shelves for storing these books. Markets for electronic "books" and other forms of multimedia learning materials are not yet established, and there are no standards to the point that libraries can afford to invest in all "systems" to store and offer these materials to users. Barriers to date are serious and complex. Probably the major obstacle is the constantly changing technology in computer hardware and software, especially varied and changing technology in microprocessors, file storage, video graphics, laser technology (CD-ROM, CD-MM, CD-I, CD-3DO, CD-Audio, Photo CD, videodisc, videodisc-digital, etc.), operating systems (MS-DOS, Amiga DOS, Windows, Windows NT, Windows Chicago, Windows Cairo, OS/2, Workplace OS, Apple/Mac Systems 7 and 8, Taligent Pink, PowerOpen, NeXTSTEP, Unix, SCO, AIX, HP/UX, HP/MPE, Solaris, and UNIXWARE, etc.), hypermedia software in over 40 varieties, and networking hardware/software. Vendors
seeking market dominance insist upon being unique to the point where it is analogous to having hundreds of railroad companies who cannot agree on a uniform gauge of track to be laid out in the market place. Lack of standardization discourages publishers, professors, and other materials developers from authoring and distributing hypermedia materials. It has been less of a discouragement within a given corporation or government agency that can adopt an internal standard (e.g., an Apple CD-ROM system or a Windows CD-ROM system) when developing training courses and internal communication systems.

3. International networks such as those carried on the Internet tend to be unfriendly to users, especially users who are not entrenched Unix hackers wearing caps with tiny propellers (the proverbial propeller heads). Aside from novice levels of email, networks are not user friendly. High priorities exist to change this situation in most networks but, at the moment, networks are unfriendly snarling beasts that scare away all but those willing to spend half of their working days taming them.

4. The technology paradigm shift could not be happening at a worse time in terms of academic budgets. Most campuses have not linked their buildings and offices with adequate cable (especially fiber optics) for broad band networks. Campus investment for burying this cable and linking up to international networks requires millions of dollars in new capital at a time when cutbacks are devastating existing budgets. Most of the computers in faculty offices are akin to horse and buggies in the jet age of hypermedia and networks. A 1983 desktop computer is not a 1989 laptop computer is not a 1993 notebook computer is not a 1996 arm band hypermedia computer. Campus horse and buggies are not suited to hypermedia authoring or delivery of learning materials.

5. Warm and fuzzy professors patiently "hold hands" to soothe frustrated students having learning and/or personal problems. No hypermedia author can anticipate all possible questions that learners might raise and set up interactive navigation buttons for millions of conceivably possible questions. Professors beat the machines in being able to react to unforeseen questions raised and adjustments to unforeseen paths of discourse. Some queues in complex combination (e.g., perspiration on a student's brow, atypical stammering, moistened eyes, phone messages from a parent, and the like) are best dealt with when there is physical proximity between a student and a human listener/teacher. Dennis Huston [Appendix 18, Huston (3)] stresses that learning groups often perform better face-to-face. Even though the interactive teaching machines may teach calculus details better than Professor Fuzzy, there are students who want and need lessons from Fuzzy.

6. When evaluating the learning performance of students, the electronic age offers many aids for testing and evaluation, including aids for grading writing style, grammar, and spelling. However, when performance is to be evaluated in highly subjective areas such as creative thought and expression, universities still need human faculties on the payroll. And it is not clear that our machines can replace us in setting new trends in music, art, and culture, because new trends and changed interests are dynamic manifestations that our machines are likely to lag behind in time (including changes caused by what the machines helped us to better understand). Robert Winter [Appendix 18, Winter (9)] tells of a music theory student whose admiration of Bach changed after hypermedia learning showed "how easy" it was for Bach to write the Brandenberg Concerto. Professor Winter then had to work outside the hypermedia system, face-to-face, to convince this music student that there were still reasons to hold Bach in awe. Tidd (1995) discusses various assessment scales such as the Computer Attitude Scale, the Computer Anxiety Rating Scale, and the Computer Self-Efficacy Scale. Assessment is very difficult because no matter how good the findings are in an empirical study, the relevance of those findings quickly falls away due to constantly emerging technologies that are significantly better than older technologies used in the study.
7. With so much opportunity for learning at the tips of their fingers, students and faculty may become indecisive about what tracks to pursue in depth --- the kid in a candy store syndrome. Also, there is a temptation while authoring in hypermedia software to get caught up in developing an expertise in the method (hypermedia authoring) at the expense of the content of what is being authored. In other words, there are many technological distractions.

8. "Presidential visions influence faculty work life about as much as political-party platforms shape the day-to-day decisions of governmental agencies," The Chronicle of Higher Education, September 22, 1993, p. 1. As noted by McClure (1993, p. 41), efforts to "reengineer instruction" in colleges is far more difficult than, say, reengineering training in business firms because "you cannot reengineer a process you do not control." Whereas business firms tend to be hierarchical with considerable centralized power residing in top executives, college top executives have very limited influence over faculty engaged in teaching and research. Also, quality of output and performance is more difficult that in business firms producing products with more specific quality specifications. This makes ex ante and ex post reengineering evaluations more difficult.

9. Effective use of technology may require huge changes in the credit-for-contact model that is pervasive in educational systems. Such drastic changes are both difficult and risky in time-honored structures. Heterick (1993, p. 1) states:

   The overwhelmingly dominant model of instruction in American university education, especially at the undergraduate level, is credit-for-contact. In this model, the student's progress and the faculty member's instructional contribution are measured by hours of contact in lecture hall, seminar room, or laboratory.

   Effective use of technology may be optimized only when departing from the contact hour structure. For example, faculty who take on a greater role in customized curriculum design and helping students access networked learning materials may have to spend more time "on call" as needed by students on network and less time in formalized class, seminar, or lab settings. Most faculty and institutional structures are not yet open to radical changes needed for adaptations to evolving learning technologies.

10. Whereas workstations for CD-ROM and other PC/Mac desktop recording have become relatively inexpensive for educators who want to author their own student learning materials, workstations for authoring of interactive television on CD-3DO and CD-I discs are just too expensive for most educators and/or education departments. This confines the consumer offerings of interactive television mainly to games and entertainment whereas the CD-ROM offerings include many more interactive computer educational offerings. Educators would like to see the prices of authoring for interactive television become more within our reach.
In our viewpoint, the above frustrations are only temporary obstacles. Our research results show signs of change in the distant horizon. Universities are becoming more conscious of the quality of teaching and learning that takes place both on and off campus. In spite of budgetary crises, colleges are somehow networking departments on campus, connecting to international networks such as those on the Internet, transforming traditional classrooms into electronic classrooms, upgrading libraries for new electronic technology, investing in some multimedia workstations to be shared jointly by faculty members, and upgrading faculty office computers. The change in structures and incentives for faculty to author hypermedia networked learning materials will be slower but may, in time, follow suit. The unwillingness of faculty to invest time and money in developing learning materials and conducting education research using new technologies probably will not change to any great extent until university and/or mass market reward structures change. However, some analysts like Moberg (1993, p. 38) are more optimistic:

Everyone who works in higher education knows that teaching and learning are evolutionary, interactive processes. Rarely do faculty members teach the same course the same way twice. New fields of inquiry and study emerge, often as “cross-disciplinary” or “multi-disciplinary” hybrids. This will continue to happen with or without the use of information technology. But the drive to make more effective use of computing and networking resources which are already in place will cause major changes whether or not this effort is planned as deliberate strategy of improvement.

The Accounting/Auditing Classroom of the Future

The key to success in a knowledge-age economy isn’t education. It’s a high-tech, ultra-customized process that I call “hyper-learning” (HL). By making use of the enormous range of knowledge resources now available, anyone plugged into the multimedia network being born from the fusion of cable TV, personal computers, and telephones will have access to more customized instruction than any school or university can hope to match. The result, hyperlearning, is to classroom education what the M1A1 Abrams tank is to the chariot.

Perelman (1993, p. 62)

Some analysts like Perelman (1993, p. 62) predict that “within 10 years, schools will be obsolete” and will be replaced by a “video dial tone” turning homes and offices into “virtual campuses.” We do not subscribe to such extreme forecasts. In Jensen (1993), the continued need for classrooms and teachers in the presence of students is outlined.

Network education, however, is exploding worldwide. New York University School of Continuing Education in 1991 commenced a comprehensive “Virtual College” computer network education service that will provide instruction in a wide range of courses in a comprehensive curriculum, conduct examinations, monitor course projects, and field inquiries from students virtually anywhere in the world. The coordinator of auditing instruction in the Virtual College is presently Professor Richard Vigilante. For example, an internal auditing curriculum is now available for practitioners around the world. The Virtual College has four modules termed Student (course discussions, project development, email, cafe discussions, student newspaper, course evaluations), Faculty
(curriculum, grading, course production, email, research support, committee support), **Library** (course hypertexts, case study materials, reference books, journal articles, audio/visual materials, online database gateway), and **Administration** (student inquiries, admissions, registration, transcripts, CPE certifications, faculty records, alumni records) modules. Learning materials include Lotus Notes and databases of various types. To our knowledge, no on-line hypermedia learning materials are yet available on either networks or CD-ROM discs. There are, however, television and teleconferencing education courses available in 85 countries. For example, a 16-credit Advanced Professional Certificate (APC) package is now available for information systems auditing.

Although much of the hypermedia learning in the future will be on networks outside classrooms, it is exciting to sit back and stare into space dreaming of classrooms similar to the electronic court chamber at the College of William & Mary School of Law. Deloughry (1993a, p. A22) reports on this high tech chamber as follows:

> The Law School at the College of William and Mary last week unveiled a state-of-the-art moot courtroom that school officials say is unrivaled in higher education.
> The courtroom at the Marshall-Wythe School of Law here is also more advanced than most functioning courtrooms in the United States, where videocassette recorders are often considered high-tech.
> The wood-paneled courtroom boasts two large television screens, a computerized transcription system, an automated videotaping system, and computers attached to the judge's bench, the witness stand, and the desks of the court clerk, the prosecutor, the defense lawyer, and each of the eight jurors.
> The computers can be used to connect to legal data bases, to review a transcript as it is being typed by a court reporter, or to view animations, graphics, or video segments that might be offered as evidence in a case.
> "We think this is going to be something very, very significant in the future of the justice system," Paul Marcus, acting dean of the law school, said at last week's demonstration of the courtroom's technology. "This will allow us to train lawyers for the future."

Instead of a multimedia court chamber, the auditing applications could be simulated audit engagements; information systems applications could be simulated business firms; and accounting applications, could be a simulated hearing before the FASB or SEC. Ethics conflicts could be role played in more realistic dramas, and students could play a part in simulated courtroom dramas of accounting firm litigations. The accounting electronic classroom(s) would need to be more flexible in terms of changing the "sets" of the classroom "stage." But the electronic equipment and software could be very similar to the electronic court chamber of College of William & Mary School of Law.

For example, when debating an accounting standards issue, hypermedia video of actual testimony before the FASB coupled with hypertext random access to actual written responses to Exposure Drafts could become the focal point of student interactive learning in the simulated FASB classroom. Students could assume the role of FASB Board members forced to make decisions regarding what standards to propose and what standards to adopt. Other students could take on advocacy roles of other segments of society in the hypermedia classroom setting similar to the William and Mary electronic court chamber. Realistic simulations of audit committees and corporate board of director meeting could become part of the student learning process.

Still another scenario for classroom instruction of the future is the Center for Computer-Assisted Legal Instruction (CALI) that provides software and coordinates the distribution and use of computerized course modules in legal studies. Details of CALI are provided in Appendix 5.

The paradigm shift of technology in education is already set into motion in virtually every academic field at every level of education and training. Educators in accounting trail the pack, but there are signs of progress and interest among the respondents of the Appendices 1 and 3 surveys analyzed in this book. At the college level we are encountering some resistance that is found at the primary and secondary education levels. The
Arthur Andersen accounting firm position on this matter is as follows:

Clearly, the potential savings inherent in transforming the existing labor-intensive system are enormous. Yet, there are attitudinal barriers that must be overcome before this transformation can take place. ... The first of these pertains to teachers themselves.

Measelle and Egol (1994, p. 8)

Conclusions by Professor Jensen

One unfortunate myth is that CAL always entails passive learning from a student's viewpoint. This is true if instructors only make use of electronic transparencies or other multimedia while lecturing. However, hypermedia CAL is intended to be interactive and non-passive from a student's perspective. Students may be continually asked to type or speak responses into the computer and to navigate nonlinearly based upon discretionary controls (buttons, hotwords, and menus) or challenge controls that navigate based upon the type of response (e.g., the answer to a question) given by the student. These controls are what constitute the "hyper" part of hypertext and hypermedia. CAL materials may be placed on campus network servers or distributed in CD-ROMs and floppy discs such that students may access them outside the classrooms. These materials may be sophisticated simulations or even virtual realities that are in many ways better than real-life experiences, because simulations may be repeated over and over at the student's own learning pace and may take place in future and past settings for which there are no current opportunities for real world experiences. The virtual realities may take students to wanderings through complex data terrain, foreign lands, to flexible manufacturing systems, to Savings and Loan operations that are now defunct, to stock exchanges under varying market events, etc. I find that the most popular project assignments that I have ever made are those in which my students develop their own simulations or other multimedia presentations complete with video segments, hypertext, audio recordings, etc.

Assessment of new technology in learning is impossible to formally evaluate with both rigor and practicality. The main problem is the constantly changing technology. What can be done for students after my university installed a campus-wide network is vastly different than the before-network days. A classroom failure using last year's technology may not be appropriate to compare with a similar effort using newer technology. For example, early LCD panel projections from computers in classrooms were awful. In the beginning LCD panels had no color and had to be used in virtually dark classrooms. This was a bad experience for most students and instructors (including me). Then new technology in active matrix LCD panels led to color but the classrooms still had to be dark. Shortly thereafter, new technologies in overhead projection brightness allowed for more lighting in classrooms while using LCD panels. However, many classrooms are not yet equipped with light varying controls to optimally set lighting levels. Newer trends with even better three-beam projectors changed everything for electronic classrooms, because now classrooms can have normal lighting as long as lights are not aimed directly at the screen. The point here is that early experiences with the first LCD panel technology are no longer relevant in situations where the latest projection technology, especially in fully equipped electronic classrooms, is available. Unfortunately, there is a tendency among some faculty to be so discouraged by one or two failed attempts that they abandon future efforts using newer technologies.

One of the most creative attempts to evaluate effectiveness from a Total Quality Management (TQM) perspective is reported by Prabhu and Ramarapu (1994). This is an attempt to measure learning using a TQM database that can be used to compare alternative teaching methods or entire programs.
It is easy to become discouraged with first efforts using older technologies. Many faculty and students became highly frustrated with the early complexities of using the Internet and/or campus networks that were not user friendly. Unless they took the time and trouble to become well versed in UNIX programming and became experienced hackers, the Internet turned into a totally discouraging nightmare. Now with Gopher, Mosaic, and many other user-friendly innovations in campus and international networking, the need to become an experienced hacker is vastly reduced. Mosaic turned the beasts of the Internet into educators’ best friends according to Rivera and Singh (1994). The point here is that any formal assessments of the use of the Internet prior to Mosaic are virtually irrelevant to educators considering using the Internet using more friendly navigating utilities such as Mosaic.

I have never found assessment literature to be of great importance in my decisions about when and how to use computer technology for my students, although I have gotten ideas on how to better my efforts in some areas. Readers interested in this literature can certainly find many studies praising the effectiveness of computer technology in gaining student attention, motivation, and performance. Numerous accounts of increased learning effectiveness at greatly reduced cost are available in the literature. For example, virtually all issues of Technological Horizons in Education Journal, Syllabus, Columns, and IAT Briefings contain reports of applications successes and failures. See Hodges and Sasnett (1993) for an excellent account about how college educators are successfully using multimedia technologies. A bibliography entitled Assessments of Multimedia Technology in Education: Bibliography is available free using anonymous FTP on the Internet using the following instructions from the Institute for Advanced Technology, P.O. Box 12017, RTP, North Carolina 27709, phone (919-405-1942):

1. FTP gandalf.iat.unc.edu
2. login as anonymous (no password is needed)
3. cd guides
4. get irg-11.txt

There are other IAT resource guides available using FTP from the IAT. See IAT Briefings, Spring 1994, p. 7 for details. One of the most interesting servers for technology in education is the MIT university “MIT EVAT Report-Models for the Future” at <http://www-evat.mit.edu/report/>.

There are also considerable formal evaluations of the impacts of technology on training. One of the better sources are the United States Air Force studies of J. Wesley Regian that are noted in Chapter 6 of Jensen and Sandlin (1994). There are excellent accounts of successes in applications of technologies in music by Robert Winter at UCLA and his multimedia CD-ROMs from The Voyager Company and Microsoft Corporation. For an account of a music PC multimedia network at Indiana University, see "Indiana's Famous Music School Builds Excitement, Multimedia Network,” in Columns, Spring 1994, p.2. The system called “Variations” allows users to insert their own works or the works of others into multimedia presentations across campus. A Mac music network system can be found at the Berklee College of Music in Boston (617-266-1400). This system is described in HPEC Syllabus (March/April 1994, p. 6).

I have devoted considerable effort to authoring my courses in CMS as well as revising and adding material to supplements provided in one of my textbook choices. I have subjected my students to my triumphs and my failures. I have made and will continue to make scheduled demonstrations of my work at universities and conferences around the globe. My audiences will often suffer less than optimal equipment until newer projection devices can be financed and/or come on the market. My classrooms were too dark using an LCD until my university equipped several new classrooms with three-beam projectors. I am nowhere near where I want to be in evolving quality material. Hopefully both my support equipment and my materials will continuously evolve into better things.
Neither CMS nor CAL in general is for every educator. CAL has many new and emerging options that all educators should investigate. Some accounting educators will find selective uses for materials prepared by others, e.g., commercial videotapes, compact discs, electronic transparencies, and videodiscs. Others like me will become fascinated in authoring their own CAL materials and assigning student projects for both teaching and research endeavors. The considerable time devoted to hypermedia authoring forced me to make better course preparations and generated concern about how to make my presentations more effective. My presentations are more colorful and efficient since I don’t fumble as much with acetate transparencies and chalk erasers. My students can concentrate more in class since there is less need for note taking. My students learn the material better when they are able to study technical content on our campus-wide network at their own learning paces. Classroom time is devoted more to inspiration and attention to matters that were not understood on network. My students also are engaged in participative learning on individual and group projects where they both conduct research and develop computer-aided presentations of their work. I become more involved with them by helping them author CMS presentations.

Education researchers will be devoting ever increasing energies creating new ways to use modern technology to help future generations want to learn. Educators of the future must teach more students than those in their classrooms and those who read their research papers and books. CAL is where our hopes of cost effective interactive education and training reside. It is important for educators to produce innovative instructional material for networks or for discs to be mailed to other colleges and libraries.

Two economics professors who, in studying applications of technology in economics education in the United Kingdom, came to essentially the same conclusion that we find in accounting and business studies:

Whilst there is a great potential for the use of computer-assisted learning in economics, this has yet to be exploited. Although researchers are making increasingly sophisticated use of computers in their work, a great deal of the teaching using computers lacks an innovative approach. Computer-assisted learning will not provide a panacea for addressing the questions of increasing student numbers, a growing body of knowledge and declining real resources. However it can contribute in a significant way to providing a variety of learning experiences for economics students. By this measure many economics lecturers are failing their students. (Emphasis added) Hobbs and Judge (1992, p. 71)

We encourage more professors to take the plunge like Professor Bartlett at Harvard University (with Sumatra Ghoshal at INSEAD) and commence authoring hypermedia lectures and cases. (See the CD-ROM section of Appendix 1 for a listing of what is offered by Professor Bartlett in international management.)

Once the economic and behavioral barriers to educational innovation are surmounted, the reasons for future success of multimedia and networking technologies in future learning endeavors are varied and complex. The key reasons, however, were simply stated as follows:

But the reason the new technology will prevail is that it combines the best of U.S. educational technology with the best of the famed Oxford and Cambridge one-on-one tutorials. As Sue Smith’s session at the computer demonstrates, multimedia technology allows each student to create his or her own solutions to problems by interacting with almost limitless sources of information. And it permits students to do so at their own paces and in places and at times of their own choosing. Elfin (1992, p. 110)

I was truly amazed, as were most of the 4,000 professors who converged on the San Antonio Convention Center in the first week of November to attend the EDUCOM conference. The top hardware and software vendors hawked their latest products and some of the offerings are indeed amazing. I can’t imagine teaching mathematics without using the new CD-ROMs and authoring software packages in mathematics. I can’t imaging science learning without CD-ROMs and videodiscs that are now relatively cheap and plentiful. I can’t imaging teaching without having my own gigabyte on the campus network server. I can’t imagine being invited to speak
without having my computer and a projection device at my side for the visual and audio enhancements to what would otherwise be less effective in getting my messages across to the audience. My wife sighed the other day when we were planning a trip home to visit my parents for Christmas. She remarked that this will be the first airline flight on which I will not cart along my computer after 127 successive trips in which I lugged my desktop computer (my laptop is not suited for my present multimedia dog and pony shows). Although the host universities usually say they can provide me with a computer, the bad news is that lack of standards and set up complications for most computers make it risky to rely on a “strange” computer for a multimedia presentation. Different computers meeting the MCI standards cannot be relied upon to use the same paths or file names or have a proper configuration for CD-ROM hypermedia discs that I recorded from my computer. The safe way of not adding audio or video is not the effective way for presentations and learning.

Everything that transpired at the 1994 EDUCOM conference is impossible to summarize in this short article. One thing that stood out, or rather did not stand out, came from a booth in the most obscure part of the vendor exhibit area. IBM made a grant to the University of Washington to develop the IKE-IBM Kiosk for Education. Whereas IBM and other major vendor sales teams were busily greeting potential customers at the front in the EDUCOM exhibit area, Professor Craig D. Yamashita (the Systems Programming Manager on the IKE project) was almost hidden in the back. This was most unfortunate since what he was “selling” is free to the general public --- and it is an exciting free service. Even though a large portion of the IKE server at the University of Washington is dedicated toward providing information about IBM products, the server also contains software reviews, software downloading, links to other Internet services, on-line publications, and course/curriculum materials in ToolBook. Professors who are willing to share their authored materials can put it on the IKE server at no cost. Educators can download these materials at no cost. Presently, there are over 20,000 educators connected to the IKE server and more are joining daily. The phone number for IKE is 206-534-3761 or 206-543-5604. Other links to IKE are as follows:

World Wide Web:  http://ike.engr.washington.edu/ike.htm1
Mosaic:  ftp.ncsa.uiuc.edu
Gopher:  boombox.micro.unm.edu in the/pub/gopher directory
Telnet:  128.95.32.61