INVITED PAPER

INSTRUCTION IN A POSTLITERATE CULTURE: MULTIMEDIA IN HIGHER EDUCATION *

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ABSTRACT: During the past few years, developments in computer technology have raised interest in multimedia as a transformational mode of instructional delivery. In contrast to earlier forms of audio-visual technology, the power of computer-based multimedia results from 1) its ability to combine multiple media formats under a single interface and 2) its ability to link objects within those formats in a nonlinear fashion. Effective incorporation of multimedia into the curriculum requires an understanding of the differences between presentation-mode use of the technology by educators and hands-on use by students. In addition, multimedia techniques can enhance various models of instruction, for example, the collaborative model that has received much attention in recent years. The ultimate success of multimedia will require improvements in network technology to facilitate widespread access to source materials.

KEYWORDS: Multimedia, Hypermedia, Hypertext, Applications, Instruction, Networks

INTRODUCTION

The traditional relationship between reading, writing and thinking skills has been radically altered for recent generations of students by the emergence of video as a primary source of information. In the zero-sum equation of life, the thirty or more hours per week that students typically spend viewing television inevitably means a reduction in other activities. And as most educators intuitively sense, the distinguishing skills of a literate society, reading and writing, fare poorly in the trade off.

For good or ill, students raised in the flickering glow of video technology have an affinity for learning via non-print media -- a preference for the film over the novel, the sitcom over the short story, the MTV collage over the poem, and a vague assumption that if a picture is worth a thousand words, then an hour of full-motion video at thirty frames a second must far exceed the paltry dimensions of a book.

TECHNOLOGY AND THE EDUCATOR

Over the years educators have alternately condemned video and other mass media technologies as undermining educational objectives and celebrated them as potential delivery systems for instruction. Out of this ambivalence have come a number of related trends that have variously attempted to appropriate these technologies for education, hence the advent of both the public television and the sporadic use of audio-visual aids in the classroom.

Individual educators have long experimented with slides and records, a phenomenon that has its institutional parallel in the growth of Media Centers, Learning Resource Centers, and the deployment of videotapes and audio cassettes in traditional libraries. But, at best, these media tools have received mixed reviews from educators, who recognize that not all disciplines lend themselves to such aids. Thus, despite the occasional use of a recording in class or an assignment involving the Media Center in the library, college instructors (with the frequent exception of those in foreign language and music departments) have largely shunned

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the introduction of non-text media. Lack of equipment, the shortage of suitable media materials, inadequate classroom facilities, uncertainty about the effective use of these aids, inadequate time or incentive to innovate -- these and other factors are implicated in the absence of widespread incorporation of educational technologies in the post-secondary classroom.

THE ADVENT OF MULTIMEDIA

Multimedia, a much-talked-about development, has begun to rekindle enthusiasm for educational technology. Multimedia, the use of a computer to "mediate" media -- text, graphics, sound, and video -- has the potential to transform education in the 1990s. The key to the power of multimedia is in its integration of two powerful concepts that, when joined, revolutionize information technology. The first is the computer's ability to present several media formats, separately or simultaneously, to the user. The second is the ability to provide nonlinear links within and between these media formats.

The Multi(ple) Media Distillation

As the word suggests, multimedia implies the integration of multiple information formats within a unified context. For the computer user, multimedia had its humble origins in the early efforts to combine text and graphics on a single screen and to supply relevant sounds through a computer-controlled speaker. During the past decade hardware and software have evolved at unprecedented speed to give us the ability to combine compact-disc quality sound, photo-quality still images, animation, television-quality motion video, text, and graphics on a single computer. Perhaps the closest analogue in print technology, the modern textbook with its profusion of pictures, charts and graphs, to accompany the text, pales by comparison to a hypothetical multimedia counterpart.

A textbook on the Civil Rights Movement might feature a picture of Martin Luther King on the steps of the Lincoln Memorial delivering his "I have a dream . . ." speech along with excerpts of the text. But the multimedia version could include not only the text but also a digitally remastered recording of the entire sixteen-minute speech, complete with the ambiance of the event -- the sounds of applause and antiphonal responses of the crowd and even the noise of jet aircraft flying overhead. An accompanying video clip of the event could show the size of the gathering and give a sense of the identity of the 80,000 participants. Indeed, students would not merely read about the rhetorical conventions of pulpit oratory that King employed or the emotional commitment of the Civil Rights marchers; they would see and hear for themselves.

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The Hyper Connection

The now familiar concept of hypertext had its origins in the ability of computer programming languages to make nonlinear connections to subroutines on a many-to-one basis. Thus, a unit of computer code that might be repeated again and again during the execution of the program is not actually embedded in the text of the computer code every time it is used. The repeated portion is broken out as a separate module and "called" as necessary by the main body of the program. After the module is executed, the control typically returns to the next line in the "calling" code. Modularity of this sort may be repeated or "nested" many levels deep.

When applied to linear text, hyper connections are best understood as a hybrid progeny of modular computer code and the conventional use of indices, cross references and footnotes of printed text. Again the textbook or encyclopedia serves as an excellent illustration. Print technology is inherently linear, even in latter-day incarnations such as newspapers and many magazines, which are physically laid out to accommodate skipping from one partially read column of print to another. But the textbook model, with its stream of notes, see also's, and the ever-present index, provides a grid of interconnections that the reader may choose to explore. Exploring these connections may lead to related text in the same book, to passages in other volumes in the same set (e.g., the multi-volume encyclopedia model), or in the academic research model to obscure publications available only through arduous interlibrary loan searches.

In contrast, hypertext is a computer technique that eliminates the tedium of the search, whether it is the brief interruption necessitated by turning to another page of the text or the onerous task of consulting a page from a limited-edition facsimile of a 10th century Latin codex. The hypertext link is usually activated with a mouse-click to call up the linked material to the computer screen. For example, clicking on a word might bring up a gloss; clicking on a see also . . . would link to the referenced material.

Like the programming language subroutines, the linked materials are interconnected on a many-to-one basis. Thus, in a CD-ROM encyclopedia, the text of the Gettysburg Address might have hyper links with a discussion of King's "I have a dream speech," an article on Lincoln, an entry on the politics of the Civil War, etc. But unlike programming subroutines, which are obligatorily called when the logic of the code dictates, a hypertext link, like the see also in the printed text, is an option that is exercised at the reader's discretion.

When applied to non-text media as well as text, the use of hyper links between media "objects" offers limitless potential for information technology. Not only can a variety of media types be accessed at electronic speeds, such as in the Civil Rights example, but also the multimedia computer enables random access to non-print media that have previously been available only in a linear format. For example, unlike a videocassette, which must be viewed in sequence with only a crude capability for rewinding or fastforwarding to other relevant episodes, a multimedia computer

can permit nearly instantaneous random access to specific digital video or laserdisc materials. Similarly, the slide tray, with its eighty slides locked in sequence, can be replaced by still images from a computer-attached videodisc or high quality images from a CD-ROM, all of which are randomly accessible via computer control.

Thus, hyper links enable both a richness of experience and a flexibility that have profound implications for information technology in general and education in particular. Because of the obvious analogy between hypertext and the textbook model of cross references, the value of hypertext is quickly apparent to the first-time user. But the full implications of hyper connections to and among non-text media will take years to assess.

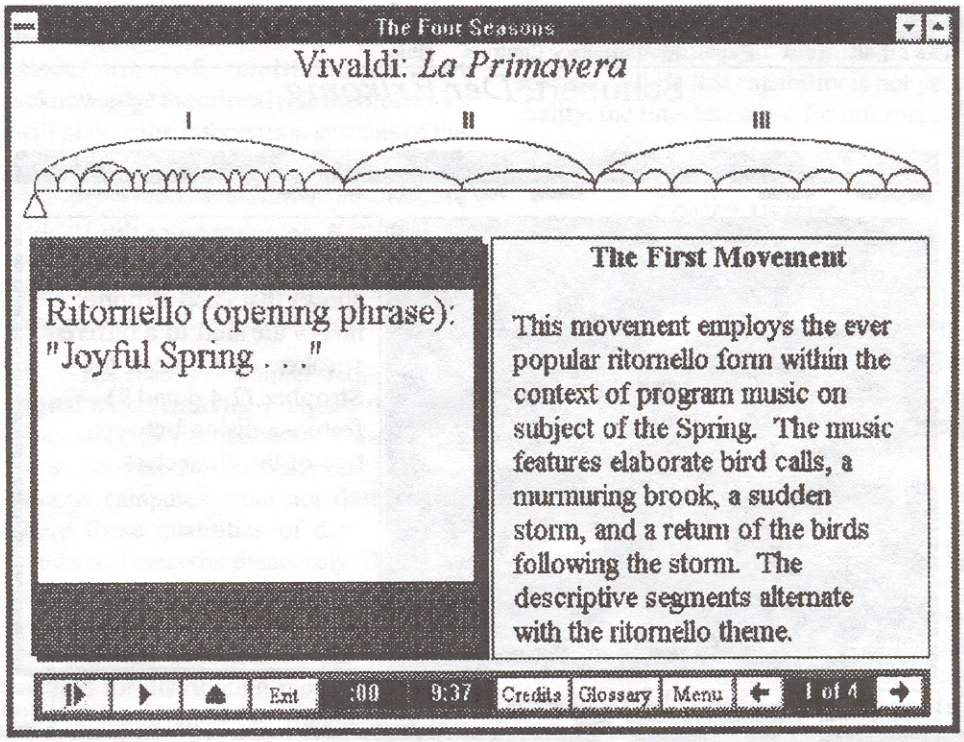
EDUCATIONAL USES OF MULTIMEDIA

The uses of multimedia technology in higher education are manifold. In the humanities classroom, for example, areas for exploration include the contrasts between spoken and written texts, the relationship between literature and performance, visual reinforcement of textual analysis, and the application of analytical methods to non-text media.

The fundamental change enabled by multimedia is well illustrated by the potential impact of the new technology on music education. The most widely taught music course in post-secondary institutions is the introduction to music appreciation, a course that relies heavily on the ability to play illustrative excerpts from recordings.

In the heyday of the long-playing record, the instructor would spend a significant portion of class time dropping the needle two or three times at the approximate location on the LP, before coming sufficiently close to the desired passage. This practice wasted time, discouraged using brief illustrations of two or three measures, and ultimately destroyed the LP surface. The advent of the cassette tape enabled the instructor to prepare tapes of music examples in advance, but with the disadvantages of the time-consuming preparation and the lack of random access to the examples. In fact, for the instructor who valued the flexibility of the LP for random access, the cassette was never a satisfactory substitute.

Figure 1: MULTIMEDIA APPLICATION OF VIVALDI VIOLIN CONCERTO



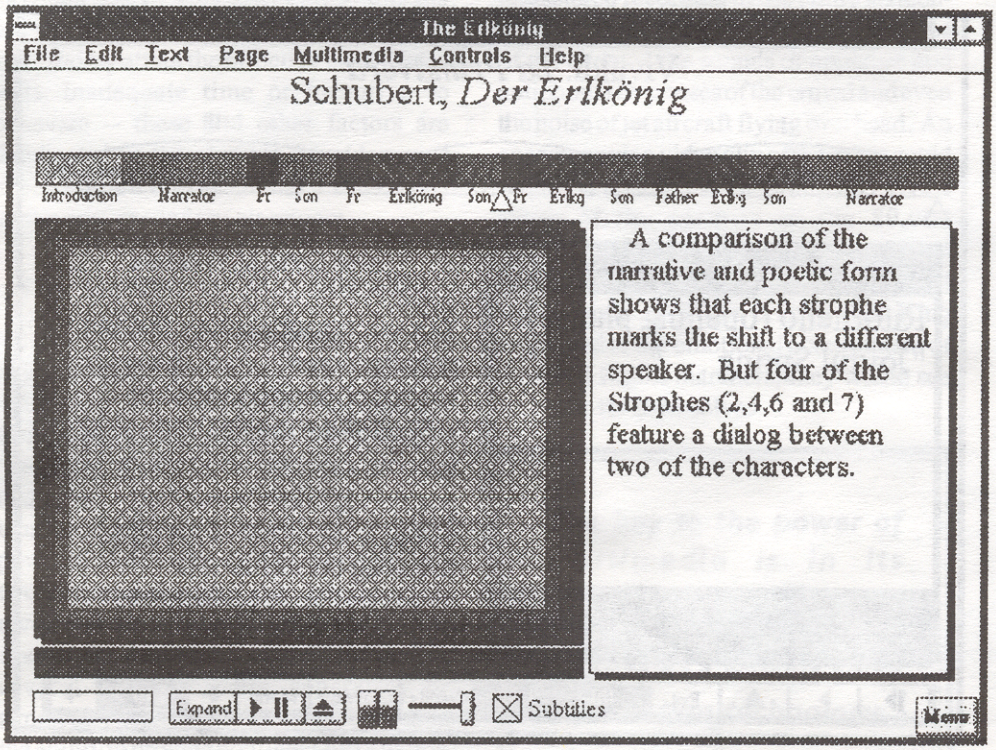
During the 1980's the advent of the compact disc brought an improvement over the cassette in random access, but with a granularity of access that is far more limiting than that of the antiquated LP. With the CD in a conventional CD player, random access is limited to the beginnings of tracks. For the instructor who wants to play the cadenza from the first movement of a Mozart piano concerto six and a half minutes into the track, the CD is even less satisfactory than the LP.

But when playback is controlled via the CD ROM drive of a multimedia computer, the educational potential of the music CD can be realized. Figure 1 shows a multimedia application that provides an analysis of the ever-popular Vivaldi violin concerto, La Primavera, "Spring," from "The Four Seasons." The graphic across the top of the screen gives a formal analysis of the three movements of the work, with each semicircular segment of the chart (or "bubble") corresponding to a discrete thematic element of the music.

The graphic is precisely scaled to a CD performance of the work, and each bubble is, in hypermedia parlance, "hot." A mouse click on the bubble triggers playback of that particular thematic element from the music CD. In addition, the pointer under the chart, which indicates the current position during playback, is also hot. It may be dragged to any location under the chart to begin playback from that point.

The Vivaldi application has yet another multimedia feature made possible by the computer -- the synchronizing of text and music. While the music is playing, the computer keeps track of the current position in milliseconds from the start of the CD. Several times a second it compares that position to an invisible database of comments on the music tagged with the time that the comment should be displayed. When the current position matches a timing in the database, the comment is automatically displayed on the left side of the screen.

Figure 2: MULTIMEDIA APPLICATION OF SCHUBERT *LIED*



With this application the instructor can modify the database of comments to suit the pedagogical needs of the students. A single musical selection can be accompanied by multiple databases, each focused on a different analytical topic, or designed for different levels of students -- non-majors, beginning majors, and advanced students.

Figure 2 shows a similar application, but this time with a videodisc of a performance of a Schubert lied. As in the Vivaldi, the bar chart across the top has hyperlinks to the playback. The video appears in the window on the left side of the screen; under it, synchronized text furnishes English subtitles to the German.

INSTRUCTOR MODE VS. LEARNER MODE

One of the most prevalent suppositions of multimedia technologists is the interactivity of computer-based multimedia. But the questions are: interactive for whom and to what purpose? Because of the expense involved in equipping full-blown multimedia computers with pertinent accessories, such as videodisc players and CD ROM drives, many educational institutions focus their initial multimedia efforts on a classroom equipped with a single multimedia computer and large-screen video projection intended for use by the instructor.

The advantages of instructor-mode multimedia over traditional audio-visual aids are readily apparent. But even though multimedia technology in this mode may improve instruction by empowering the instructor in unprecedented ways, the interrelationship among instructor, students, and the object of study remains largely unchanged; pedagogy is enhanced but not fundamentally transformed.

For computer-based multimedia to transform pedagogy, it must be placed in the hands of the students themselves. For ''Learner-Mode'' multimedia to be effective, students must have hands-on experience with multimedia computers; they must become active participants in their relationship with the object of study.

For example, after seeing the professor explore the structure of a Mozart piano concerto with the aid of a multimedia computer, the students should be given the assignment of carrying out their own analysis of a similar work. Obviously this mode requires a far more extensive investment, not only in equipment, space, and media materials but also in training of instructors and support staff.

Ultimately the incorporation of multimedia into the curriculum should go a step further, especially for those students planning careers as educators. As students develop skills in the manipulation of multimedia materials, they should have the option of completing assignments that involve developing their own multimedia applications.

For example, music students working individually or in teams might be given the assignment to create their own bubble analyses of musical forms. There are a growing number of hypermedia authoring programs that are well within the means of non-technical faculty and students alike to master. Hypercard on the Macintosh is perhaps the most familiar example. An even more powerful program for IBM and compatible computers is Toolbook (Asymetrix Corp. Bellevue, WA), which was used to create the applications shown in the figures accompanying this article.

THE COLLABORATIVE MODEL

In addition to the teacher-centered and student-centered models for incorporating multimedia into the curriculum, the technology has some special affinity to other computer-enhanced models for learning. It can be used to advantage in conjunction with collaborative models, especially in a classroom of networked computers equipped with electronic conferencing software such as the Daedalus Instructional System (The Daedalus Group, Austin, TX). It is a natural accompaniment to programs that foster the development of analytical skills, such as SEEN: Tutorials for Critical Thinking (CONDUIT Software, Iowa City, IA).

Most often viewed as the domain of the English department because of its

applicability for writing instruction, software of this sort puts students in peer-to-peer electronic interaction for a variety of collaborative activities, with peer critiquing and real-time electronic discussions among the most prominent. With the addition of an instructor-mode multimedia computer, the collaborative activities can now focus on a much broader range of media.

For example, the instructor might use an application with hyper links to a video adaptation of Shakespeare's Romeo and Juliet synchronized to the authentic text of the play. Students may then be asked to participate in electronic discussions on such topics as discrepancies between the text and video versions, the use of the camera to signal point of view, the effects of staging, costumes, and music, etc. In fact, a single multimedia system in a collaborative classroom provides an effective technique of ensuring active student engagement with non-print media materials short of supplying a full multimedia system for each member of the class.

THE FUTURE ROLE OF THE NETWORK

Any reference to networks in a discussion of multimedia must acknowledge the critical role that networks will play in the information systems of the future. At present the overwhelming majority of multimedia initiatives in higher education are based on stand-alone computers or networked machines that make only incidental use of the network in conjunction with the multimedia.

The reason is simple. High quality digital audio and video require the rapid processing of vast amounts of data. The networks that are currently installed on college campuses were not designed to move these quantities of data to large numbers of users simultaneously. However, as networks become more robust and data-compression techniques improve, the network will doubtless be the preferred method for distributing most multimedia source materials. No longer will the computer be exclusively dependent on the locally attached data devices -- the hard disc, CD ROM, or videodisc player -- for multimedia. Ultimately the network will provide the means to extend the hyper links to virtually unlimited multimedia data sources. While this capability is not yet a reality, the time has come for information technologists to begin planning for it.

CONCLUSION

During the past few decades, largely as a result of the pervasive influence of film and television, our culture has been rapidly moving beyond text-based technologies for its primary access to information. As educators recognize this trend, computer-based multimedia will receive increasing attention as a tool for learning. For multimedia to live up to its potential, it will be important for educators in general to understand the various instructional uses to which the technology can be put. Over the next decade, multimedia computers will become common in our educational institutions. The challenge before us is to discover how they can be used to best advantage.

AUTHOR'S BIOGRAPHY

Douglas D. Short is a consultant in multimedia for IBM's Academic Information Systems. In recent years he has specialized on the incorporation of videodiscs, compact discs, and MIDI into the curriculum via computer-based instructional technologies. He is one of the principal developers of the multimedia authoring software on the IBM Advanced Academic System.

In addition to his position at IBM and collaboration with the University of North Carolina's Institute for Academic Technology, Dr. Short is an Adjunct Professor of English at North Carolina State University, where he taught for 15 years before joining IBM in 1984. He left his full-time position there at the rank of Professor.

His publications include two books and over two dozen articles, mostly on medieval English and linguistic topics.

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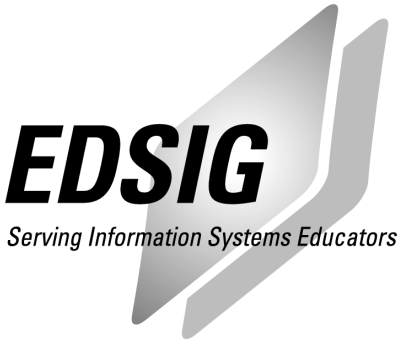

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