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Student-Developed Multimedia: An Ideal Vehicle for Writing Across the Curriculum

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A volcano erupts on the computer screen. A laser disc whirls and images appear on a television screen at the command of a computer program. Handel's sarabande from Suite no. 2 is digitally recorded and put into a computer program. A human voice says, "That is correct." when a question posed by the computer is answered appropriately by a student.

The computer programs that use these sounds and visual effects are not being developed by a large curriculum-development corporation in New York or Chicago. They were produced by students in the Computer Aided Instruction Project at R.C. Edwards Junior High in Central, South Carolina. In this project students work in concert with classroom teachers to create software for almost every subject in the curriculum. This is not an example of a junior high software "sweatshop," but rather an experimental effort to explore ways of making research and writing more engaging and meaningful for students.

The Computer Aided Instruction Project had its beginnings in an attempt to find an effective way to help more students at Edwards find success in the academic environment. Nancy Linvill, the resource teacher for learning disabled students at Edwards and coauthor of this paper, wanted to identify and promote approaches to instruction that accommodated the different learning styles exhibited by Edwards's students. She had observed that many bright, capable, creative students did not seem to respond well to traditional, teacher-centered instructional approaches, and she wanted to provide a means for them to succeed on a level commensurate with their ability.

The South Carolina Department of Education was offering multiyear grants of up to $90,000 for projects that explored innovative ways of meeting specific educational needs, so financial support was potentially available. The question was, how could such money be used to develop new strategies that would genuinely benefit the target group of students?

In search of possible directions Linvill contacted Chris Peters, a Clemson University assistant professor specializing in instructional technology (and the other author of this paper). Together they decided to explore the possible benefits of involving students in designing and developing computer software related to their regular classes.

The project's guiding premise was that by combining the benefits of writing across the curriculum (WAC) with the multisensory power and appeal of computer-controlled multimedia, learning and cognitive processing could be increased in a select group of students. *Computer-controlled multimedia* refers to the use of computers to capture, create, integrate, and present textual and audiovisual material in dynamic, interactive formats. Video material might include original electronic artwork created by students, digitally scanned photographs, motion sequences and still images from videodiscs, as well as other visual images gathered from a variety of additional sources. Audio material might include human narration, digitized sound effects, computer-generated music, and any other audio material that could enhance a particular project. All these pieces of information are combined in and accessed through a single computer-controlled environment. By harnessing the enthusiasm with which most students approach computers and channeling that enthusiasm into curriculum-based multimedia projects, the Edwards computer class is demonstrating that WAC and new technologies are a potent combination.

Why Multimedia?

The commonly stated goals of education include helping students learn how to think, solve complex problems effectively, and analyze and synthesize information to construct their own knowledge and understanding. By enabling students to become active learners, writing can be an effective tool to be used in achieving these goals. Writing Across the Curriculum extends the value of writing into content areas, by promoting active engagement of students with disciplinary knowledge. Multimedia takes matters one step farther by allowing students to design and develop information *systems* rather than simply putting words on paper in written reports. In addition to being more robust than writing alone because of the additional kinds of information involved, multimedia development encourages students to probe content matter more thoroughly as they uncover and express relationships among concepts.

Writing is still central to the process, but student efforts involve much more than simply composing and polishing the written word. The work required to execute a given project includes such elements as graphic design, simple audio engineering, public speaking, and even an element of video production. Students produce software that will be seen, read, and heard by more people than just the teacher. The concept of *writing* across the curriculum is expanded to *communicating* across the curriculum. The skills needed and the effort required necessitate that students consider the delivery of their information as a multimedia package, not simply as pages to be read. In the course of completing such a presentation students must carefully consider how audiences will view the end result. Important considerations include nuances of visual design and the effect it has on user perception, the degree to which a particular graphic might enhance or detract from effective communication, and the overall effect of the integration of text, pictures, and sounds on the understanding of someone using the program.

Multimedia information systems are usually nonlinear. This means that information need not be presented in a strict, predefined sequence. Video clips, images, sounds, and written text are all potentially accessible at any point in the presentation. To construct a logical, usable multimedia system, students must evaluate the different ways people might want to access the information and then provide means for them to do so. The end result is that students analyze the content more deeply and communicate its substance meaningfully.

Allowing students to create their own software and present it to others put them in control of the learning experience and gave them self-confidence. Students do have the ability to generate knowledge and prepare high-quality presentations. Multimedia is a vehicle for students to become partners with teachers in the educational process.

How the Project Works

The Edwards computer class is made up of teacher-selected students who have previously performed below their academic potential. Some of the students have problems with attention deficit disorder; others are creative, "right-brain" students who want the freedom to chart their own course through the curriculum. In short, the class provides an alternative for students who have difficulty learning in lecture-oriented classes.

In the computer aided instruction class, students work on projects for other courses they are taking. Students confer with subject-area teachers about topics they will be studying in the future in order to select a theme for a project. Then they design a computerized, multimedia "term paper" about the topic and begin executing it using HyperCard software on Macintosh computers. HyperCard is a multimedia "authoring tool" that lets nonprogrammers create sophisticated computer software. The end result is called a HyperCard *stack*. When students complete their stacks, they use them to teach their classmates about the researched topic. They also let their teachers use the stacks for presentations to other classes.

Students begin their HyperCard projects by gathering information. They use traditional methods of doing research in the media center, such as finding books, locating periodicals, and exploring encyclopedias. Some students conduct interviews with local experts to obtain firsthand information about a particular subject. Information gathered in the interviews and from other research is combined, outlined, and laid out in a written structural plan for use in developing the HyperCard stack.

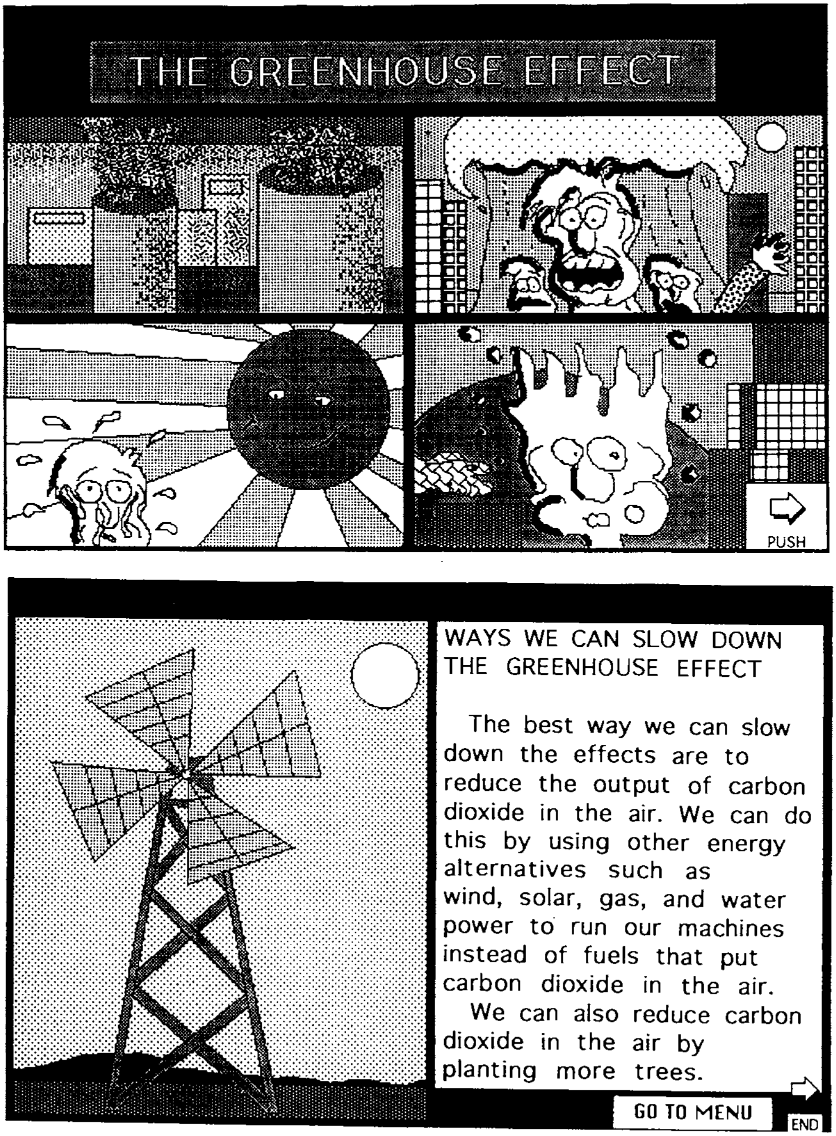
First attempts to research topics for HyperCard projects are typically a struggle for students, requiring more time and effort than expected to find the needed information and materials. Many students have never conducted this type of research and are frustrated with the process of locating what they need. Edwards media specialist Edmee Reel believes the class provides an unusual opportunity for students to sharpen their research skills. They are motivated to spend the effort necessary to become proficient researchers because projects have personal meaning and because they know their work will be used with a wider audience than most classroom assignments.

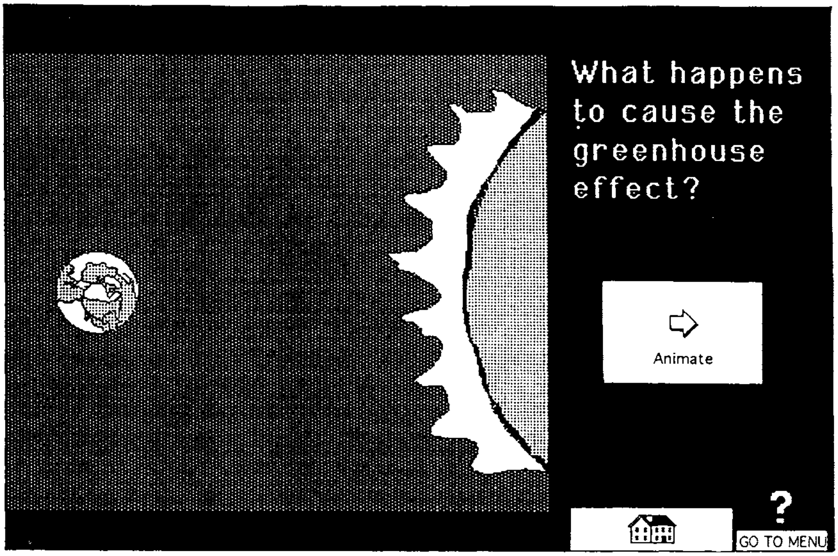
Using computers to create their projects seems to clear up the "writer's block" that frequently confronts these students when working on purely paper-based assignments. The payoff for the research is in transferring the results to the multimedia environment, and that goal keeps students motivated during the frustration of the research itself. One student in the class said, "I wanted to sit down at my computer and work rather than talk after I had the information on note cards."

Once the information is gathered and plans are written and critiqued by fellow students and teachers, students begin to construct their stacks. A typical stack consists of a number of screens or "cards" that contain pictures, boxes holding textual information, and buttons that may be activated to move from one screen to another. Buttons are also used to access video clips stored on videodiscs, to play sound effects or spoken narration, and to call hidden textual information onto the screen. While the essential building blocks (pictures, buttons, text boxes) of all stacks are similar, the arrangement of those elements and the specific information they contain are different in each project.

Figures 5–1 and 5–2 are screens from two students' stacks, *The Greenhouse Effect* by a ninth-grade boy, and *The Solar System* by an

Figure 5–1
Greenhouse Effect



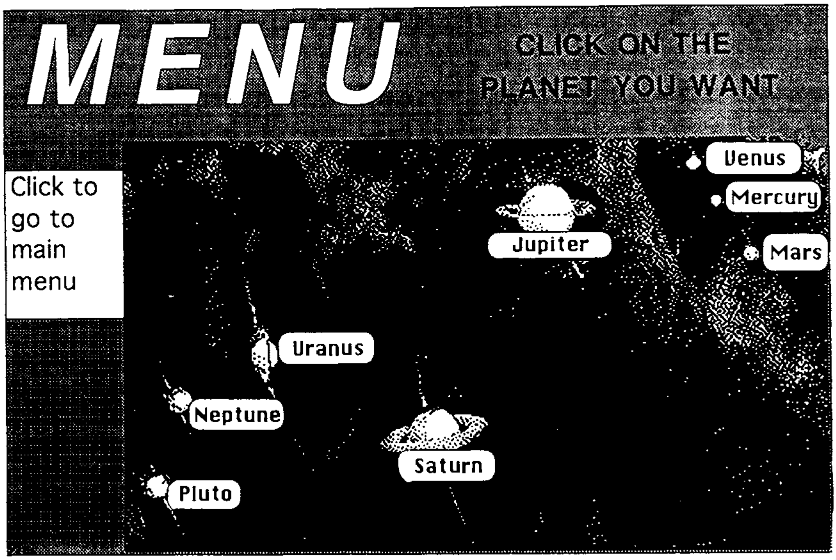


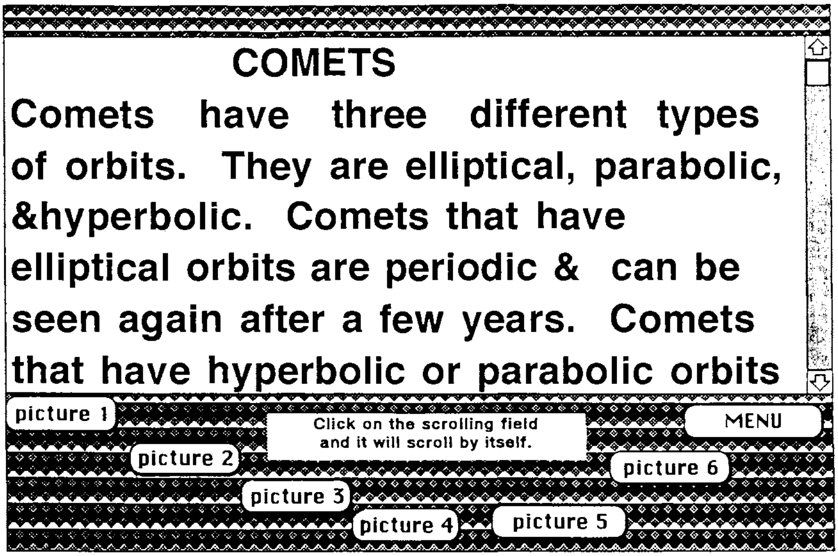
eighth-grade girl. Notice how each stack accomplishes similar goals in presenting information and allowing the user to browse through it, but the visual look and feel of each, as well as its underlying structure, are completely different and individualistic.

The designer of *The Greenhouse Effect* is a talented artist and has opted to use original electronic drawings as the graphics in his stacks. His Greenhouse Effect stack is divided into three major sections (Information About the Greenhouse Effect, Effects of the Greenhouse Effect, and How We Can Slow Down the Effect) Operators may use buttons to move easily from one section to another. The stack includes an animated sequence of sunlight approaching and striking the earth and uses sound effects with a synthesized echo added. The stack is an example of good information expressed with the help of a fertile imagination.

Laura Smith, the designer of *The Solar System* is meticulous and structured in her research. Her stack is packed with pictures and written information, and its structure reflects her systematic approach. The stack index is a view of the entire solar system. In order to get more detailed information about a particular planet, the user clicks on the image of that planet in the solar system diagram. The program then advances to that planet's section. In addition to presenting onscreen text and graphics, Laura has tied certain sections of the stack to appropriate material on a videodisc which the user can access as desired.

Figure 5–2
Solar System





Working on the computer is fascinating for all students in the class. With HyperCard, students are able to free their imaginations and learning potential as they write. If words fail them or simply aren't sufficient to convey the ideas students wish to share with an audience, they can amplify the text with sounds, pictures, animation, and material from laser discs.

Rachel McLaurin completed a HyperCard project on atoms for her science class. "Atoms do not thrill me and I would not have enjoyed doing a typical written, research project on this topic," she explained. "If I don't like the subject, I don't like to write papers. With a paper you are just typing and the only thing you can change is the ink. I would just type dull information." She found that by using HyperCard to present her information, writing and illustrating a stack about atoms was fun and much more interesting. "I scanned a picture into my computer of a gold foil experiment by Ernest Rutherford. I also scanned a picture of an atom and used it several times in my stack. When I wrote about a positive center to an atom, I was able to change the picture and put a positive center into it. If you use a computer you take more interest in your work and learn more than if you go to the encyclopedia and do the work just for a grade. With HyperCard you have to get the information ready for a class presentation. To do that, you have to really learn what it's about. I get into it because I will show it to my classmates and I want it to be good."

Students present completed HyperCard stacks as minilessons to their classmates. An enlarged view of the computer screen is displayed with an overhead projection panel, and sound is amplified through speakers plugged into the computer. Knowing that their stacks will be shown to others encourages students to produce better work than they normally would for classroom assignments. Alton Owen said that he works differently when he knows that several of his classmates will be looking at his project. "I make it better than if only a teacher were to see it. It's a lot harder to do a halfway job when I'm going to show it to others. I need to get everything right, like the spelling."

Grades and Evaluation

Grading was as unconventional and experimental as the course itself. Students filled out a contract at the beginning of each week and wrote down project-related goals they wished to accomplish during the week. At the end of each day, they wrote a brief statement of what they did. On Fridays the teacher had a short conference with each student, discussing whether or not the goals had been accomplished and what might have been done differently to help achieve all goals. Students summarized their own views regarding the quality of their work for the week, and their assessments were taken into account in assigning the week's grades. Then students and teachers together agreed on a grade for the week. The students were also given a grade for their research and presentations, based on a simple checklist.

Edwards students take semester exams that represent one-fifth of their grade. For the semester exam in the multimedia course the students were given an incomplete HyperCard stack and asked to complete it. They were expected to make a title screen, put in a digitized sound, script "buttons" to allow users to move among screens, and use visual effects to enhance screen transitions. Work was evaluated with a checklist for each item completed on the test.

Results

Few observers will mistake the finished HyperCard stacks as the work of professional software design teams, yet the students' projects are invariably intriguing, and the students are justifiably proud of their creative work. Upon project completion students have the satisfaction of knowing that their efforts have paid off in the production of tangible products that they will share with others. The students enjoy the attention and frequent visitors the HyperCard classes receive, as well as their moments in the spotlight when they are asked to make presentations. With classes of unmotivated "underachievers," the software-development class has become a highly productive endeavor that is routinely cited by students as their favorite class and the one thing they really enjoy at school.

What is perhaps more important is that many of these students, who have been unsuccessful in regular classroom situations, and might logically be described as being "at risk" or even failures by normal standards, become effective learners. In addition they are able to generate information that is useful in teaching others. There is good chemistry among the students. Underachievers mix closely and well with high achievers. As new programming tricks or design features are discovered and shared, the students' roles switch continually from being learners to teachers to independent multimedia producers.

Edwards faculty members are equally positive in assessing the accomplishments of the software-development efforts. Many have become motivated to learn more about HyperCard so that they too can develop class materials.

Elaine Lesley, an English teacher at Edwards, observes that computer students are proud of themselves when presenting HyperCard stacks to their classmates. She believes that their self-esteem is enhanced by being able to respond accurately to their classmates' questions and that the outside reading done by the HyperCard students allows them to answer questions with assurance. Lesley plans to keep student-made HyperCard stacks and use them in future years with classes. She thinks students are pleased that the stacks will be used in the future, noting, "We all like to think we are leaving something useful behind."

Connie Stockunas, an Edwards science teacher, has had several HyperCard projects presented for her classes. She reports that HyperCard computer students make better grades in her class when their researched topic is being studied. She says, "The HyperCard students pay more attention during discussions and enjoy giving out information about what they already learned."

John Wade, former Edwards Junior High principal, says that the HyperCard computer class increased students' motivation and confidence. When he walked into the computer classroom, he noticed that students would push back their chairs and back up so that he could see their work. In other classes he said these same students would sometimes cover their papers with their hands so that their work would not be seen.

The community surrounding Edwards has been supportive of the HyperCard project. A committee composed of parents, teachers, and business people has acted as an advisory group and has met periodically to stay informed about the program's progress and to promote awareness of the project. Supporters at Clemson University have made many visits to Edwards, troubleshooting hardware problems, training teachers, and observing the students in action. The local Rotary Club donated money to buy an additional computer.

Attention has also spread beyond the Edwards community. Numerous newspaper articles and positive editorials about the project have appeared. The newsletter published by the South Carolina Department of Instructional Technology has run a feature on the Edwards project, and representatives of several schools have visited Edwards to explore the possibilities of adopting similar programs in their schools.

Lessons Learned

The project has functioned smoothly for the past two years, but there were many unexpected obstacles that had to be overcome. Despite being very straightforward and "user friendly," HyperCard is not something one learns immediately. The two computer class instructors had no programming experience and had never used HyperCard or Macintosh computers before the project began. A one-day training session and a box of training materials donated by Apple Computer helped get things rolling, but by themselves these were insufficient to keep the class afloat. Achieving HyperCard proficiency required much trial and error, many false starts, and occasional teeth gnashing. It helped that the students and teachers adopted the role of colearners, sharing new discoveries and techniques as they emerged. Teachers assumed guidance roles, and students had to become problem solvers, often working in tandem to tackle a particular programming issue.

It also became apparent that, as computer novices, the teachers needed to have outside help available. Frequent calls to the local computer vendor and to university faculty with multimedia expertise were necessary to survive the first year. The second year was considerably smoother and calls for help were fewer and far less frantic.

Another difficulty was a hidden partner of multimedia's appealing robustness and variety. Students were so intrigued with the technology that they could easily get off track and waste time playing with the computer's capabilities. Digitized sound effects and digital recordings of the students' own voices were frequent distractors. Some play was desirable and necessary to help students become proficient with the technology, but it could easily get out of hand. Maintaining a balance required active monitoring by the instructors and occasional intervention to nudge students back onto a project-oriented path.

Despite the added appeal of the computerized environment, students did not find all of the project's activities enjoyable. Using the computer was fun, but preparing a good multimedia presentation required a significant amount of research and planning. Many students found these processes cumbersome and preferred to sit right down at the computer and start creating without a plan or a fixed direction.

While the faculty and administration at Edwards have been highly supportive of the project and pleased with its results, there are nonetheless several internal obstacles to the project's continued success. A few teachers were not receptive to having students take over part of their planned lecture time to present a multimedia package. It was not always clear if the reluctance stemmed from the perceived difficulty of integrating students' instruction with the teacher's or from an unwillingness to relinquish control of the classroom for even a short period of time.

The length of time it took for students to execute a project also sometimes interfered with presenting multimedia projects to other classes. Whereas a typical term paper might take two to three weeks to research and write, a multimedia package could take anywhere from four to twelve weeks to develop. By the time a project was finished it was sometimes too late to be of much instructional value in another class.

Looking to the Future

The chief lesson learned from the software-development experiment has been that the intelligent use of technology can benefit the learning of every subject. Relegating multimedia to multimedia classes makes no more sense than confining writing to writing classes. If educators are to truly capitalize on the benefits of new information technologies, use of these technologies must be woven into the very substance of the curriculum. Students must have access to technology as they need it—not only within a technology-related class, but within every class.

One Edwards teacher, Tab Hughey, had all students in his eighth-grade South Carolina History class do a multimedia project about an event in the Revolutionary War. J. R. Adkins, a student in the class, said, "Doing my project about Bunker Hill helped me understand what really happened during the Revolutionary War. It will stick with me more than if I had done regular classroom activities. We didn't cover as much material while we did the multimedia project, but we went more in depth." J. R. added that he learned not only from creating his stack about Bunker Hill, but also from viewing his classmates' HyperCard stacks about other aspects of the Revolutionary War. We are hopeful that there will be more widespread use of multimedia design as a part of regular classwork at Edwards in the future.

Attempting to provide universal access to multimedia production is, unfortunately, a challenge currently beyond the means of most schools. Increased student access to computers requires purchasing a greater number of systems at a time when there is often not enough money for school essentials, much less for technology purchases. At the same time, for those who have money, choosing the right hardware is like shooting at a moving target. Each year seems to bring better computers at a lower cost. The difficulty of purchasing systems that will not seem obsolete in the near future is a serious enough dilemma that some schools put purchasing plans on hold indefinitely.

Until funding allows schools to infuse more technology into the everyday classroom, and until schools are willing to commit to the ongoing support of the use of that technology, educators are caught in an unfortunate predicament. We can't afford to obtain the facilities needed to give every student access to the technology, yet the technology is potentially so pedagogically powerful that we can't afford to wait. In the meantime, for all their successes, classes such as those taught at Edwards run the risk of remaining novelties, intriguing some and inspiring others, but not really affecting the lives of the majority of students who desperately need what the technology has to offer.

The hope is that as more schools successfully demonstrate the value of multimedia in every curriculum area, the status of multimedia (and the hardware required to support it) will change. Perhaps in the not too distant future, instead of being seen as a luxury made accessible to select groups of students, multimedia will be perceived as a school fundamental. The focus will no longer be on the technology or the hardware, but entirely on the learning taking place. Given education's track record with technology and our seeming inability to capitalize on its potential, this might seem overly optimistic. Nevertheless, the demonstrated power of multimedia to motivate students and promote learning makes pursuing that hope worthwhile.

Appendix
Logistics

Hardware

While the ability to integrate different media into a single presentation might seem futuristic, the hardware is readily available in many schools already. The Edwards computer lab houses seventeen Macintosh computers (a combination of ten SEs, four Classics, one LC, a IIcx, and a IIci file server), an Apple flatbed scanner, a laser printer, a videodisc player, and three CD-ROM drives. HyperCard comes bundled free with every Macintosh computer.

The lab setup allows whole classes of students to be involved in multimedia development at the same time and allows resources such as the lone scanner to be shared, but fewer systems integrated into regular classrooms could still be used effectively.

The cost of the lab's original twelve computers and other hardware when purchased was approximately $30,000, but prices continue to drop. To equip a similarly configured facility at this writing (Spring 1992) would cost approximately $18,000. An individual "creation station" consisting of a Mac Classic, flatbed scanner, videodisc player, and a CD-ROM drive would currently cost around $3,200.

Materials

Several good reference and training books are now on the market to help with multimedia development. Danny Goodman's *The Complete HyperCard 2.0 Handbook* (Bantam) is the single best HyperCard reference book and should be considered an essential resource in any HyperCard project. Also worth investigating are the manual that Apple includes with HyperCard and the myriad of educational HyperCard books beginning to appear on bookstore shelves.

There are at least two other widely available sources of information that would be helpful to anyone undertaking a serious project:

1. Organized training either through college classes or conference workshops can be very helpful. Single-day sessions can sometimes present more information than can be effectively absorbed by

participants, but they can still be tremendously worthwhile. College classes usually offer training that is spaced out over longer periods of time, allowing a more relaxed opportunity to master the basics in stages. At present, however, multimedia classes are not routinely offered by schools of education, and such training may be hard to find.

2. Perhaps the cheapest way to sharpen HyperCard technique is the examination of stacks created by more experienced developers. One of the nice things about HyperCard is that it is relatively simple to break into a stack to see how something is done. Stacks are routinely available for free through on-line services such as GEnie, CompuServe, and America On-Line. They can also be purchased very cheaply through companies such as EduCorp (800-843-9497) or computer user groups such as the Boston Computer Society (617-625-7080) or the Berkeley Macintosh User.