MULTIMEDIA EDUCATION: WHY PRINT ISN'T ALWAYS BEST

BY PATRICIA M. GREENFIELD

FOR MANY people, print — reading and writing — is still the hallmark of education and the standard against which all other media tend to be measured. Those with this view often perceive television, film, and the newer electronic media as a threat to print. Each medium, however, has its own profile of cognitive advantages and disadvantages, and each medium can be used to enhance the impact of the others. It makes little sense to treat print as if it is best at everything.

My theme is that each medium has a contribution to make to education and human development. One medium's strength is another's weakness; thus, the media are complementary, not opposites. For example, film or television emphasizes action and simultaneous events. Print, in contrast, emphasizes a linear, sequential relationship between ideas or events. Thus, to receive information on the same topic through different media is to learn about the topic from different points of view. The newer media should, of course, not be allowed to take the place of reading and writing for our children, but we must begin to think more seriously of moving from domination by a single medium to an increasingly multimedia education system.

A multimedia approach to education has four major advantages: First, as the literature on media in education consistently shows, a multimedia approach to a subject can be a more effective way of teaching than a single medium in isolation. One likely reason for this finding is that each medium is good at presenting certain types of information while relatively poor at presenting others. Therefore, a multimedia presentation of a subject provides a more complete informational picture than any one medium alone. Second, since each medium emphasizes certain ways of thinking and modes of perception, multimedia education can help children develop new skills, skills that print alone does a poor job of fostering. Third, television, film, video games, and other computer technology are here to stay. We don't have the option of eliminating them from children's lives during their nonschool hours. But we do have the opportunity for influencing children's use and perception of the different media, making their responses more active, more sophisticated, more critical. Just as the value of print gains enormously from critical classroom discussion, so too can the other media. Fourth, bringing the electronic media into the schools could capitalize on the strong motivational qualities that these media have for children. Many children who are turned off by school are not turned off by one or another of the electronic media; quite the opposite. An educational system that

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capitalized on this motivation would have a much greater chance of success.

THE QUESTION of whether a multimedia approach to learning is superior to a single-medium method was systematically explored in a study that looked at the role of computer simulation in teaching high school physics. Experiments were set up that could be done either in the laboratory or on the computer. One group of students did the experiments on the computer only; one group in the laboratory only; the third group combined computer and lab, doing one trial of each experiment in the laboratory as an example but using the computer to collect data for analysis. The combination of computer and lab was most effective for the largest number of outcome measures: This group was able to reach conclusions more effectively and had the highest exam scores. The computer alone was most effective in teaching how to investigate relationships between laboratory variables. The laboratory-only group was not superior to the other two groups on any outcome measure. The teaching of science provides numerous examples of the advantages of adding nonprint media to the more traditional methods of instruction. Because so much of science involves action and transformation — whether it be cell growth or a physics experiment — video or film, with their moving visual imagery, are well suited to presenting scientific material. A classic example is a film using time-lapse photography to show plant growth. In such a film, physical transformations, invisible to the naked eye and difficult, if not impossible, to describe in words are made real for the learner.

Likewise, video can be very useful in teaching manual and physical skills — trades, crafts, sports, etc. In England, filmed motion was compared to still pictures as a way to teach children ages four to eight how to put together a complex wooden puzzle. While the still pictures did help some (compared with no instruction), the filmed demonstration led to the greatest success with the task.

Another advantage of visual media involves the key element of retention of information. Research indicates that audio and printed material stimulate the imagination more than does television or video. Lacking visual images, audio and print "leave more to the imagination" than does television. This irreplaceable quality is one of the many reasons we so strongly encourage children to develop listening and reading skills. Yet our research also shows that the very visual imagery that is bad for imagination activity is good for memory. For example, we find that if children are presented with the same story in an audio version and a video version, they remember the main points better from the video version. This finding has important implications for education, since one of the teacher's major problems is always how to make something "stick" in the student's mind. This research indicates that student learning and retention would benefit from movement away from the oral language emphasis in classroom activity to greater use of visual media such as television or film.

A DISTINCTIVE quality of computer technology in general is that it provides an opportunity for learners to interact with complex, dynamic systems, as in simulations. Computer simulations are, therefore, well suited for teaching about any complex, dynamic real-world system such as a corporation, a battle, a government or an ecosystem. The simulation allows the student to alter, in a way that print cannot, the condition of one or more components and see the consequences or possible consequences of this alteration on the rest of the system. A computer simulation of the major military events of the second world war could, for example, show students what might have happened if the Germans had captured Stalingrad or if they had invaded Britain rather than attacking the Soviet Union.

One of the first simulations to be developed for young children was called Lemonade Stand. In this simulation, you, the player, start with supplies for making lemonade (provided by your mother). The program gives you information relevant to consumer demand for lemonade (such as a weather forecast), and you have to decide how much lemonade to make and at what price to sell it. The computer then calculates the profit you would make under those conditions. In later turns, your mother stops providing you with sugar, and your decision making must also take the fluctuating price of sugar into account, the goal being to maximize profit.

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This simulation builds on a real-world model that is familiar to many young children, the lemonade stand. However, it should enable children to go beyond their everyday knowledge of the model to understand relationships between variables such as cost and profit, supply and demand. The computer simulation enables children too young to comprehend abstract discussions of profit, loss, and so on to learn through *doing* how economic variables operate.

Another example of the relative strengths of each medium for learning and education is the interactive quality of both video games and computers. In a video game such as Pac-Man, the player controls the major character and influences what takes place on the screen. Similarly, in a battle simulation, the player makes choices that affect the outcome of the war. Unlike television, where information flows in one direction only — from screen to viewer — computer technologies are interactive because they involve a two-way flow of information. In some computer applications, such as word processing and computer graphics, the child has virtual complete control over what develops on the screen. This interaction forces children actively to create stimuli and information, not merely consume them.

As Piaget and many others have pointed out, active learning is more effective than passive, and computer technology is an ideal medium from this particular perspective.

IN MY experience teaching developmental psychology to university undergraduates, I have found the various media to be complementary. I use audio recordings to present experiments that are primarily verbal in nature. I use film and video to show children's behavior and reactions at different ages and to show environmental settings that would not otherwise be accessible to most students. For example, it is virtually impossible to describe infant reflexes in a way that is meaningful to someone who has never seen one. Film lets the students see it. Through film, my students are able to observe infant care on an Israeli kibbutz or to meet a family that has lost a child to Tay-Sachs disease.

Film can get students emotionally involved with the material, and I take advantage of that, using film as a basis for group discussion. But the lazy habits born of too much entertainment television can cause students to consider the films as breaks in the class, opportunities to "space out." It is necessary to establish a context for their active involvement with the film material. I do this primarily by telling the students that the films are integral to the course and they will be tested on them. I also introduce each film, embedding it thoroughly in the structure of the class — a technique that has been shown to enhance learning from a film. An informal survey in my classroom confirmed an experimental finding mentioned earlier: A film image makes a point from lecture or reading more memorable.

After showing a film, I use lecture to relate the concrete examples presented in film to general facts and theories. For example, following the film of the Tay-Sachs family, I might talk about the frequency and genetic mechanism of Tay-Sachs disease; after a film showing infant care on a kibbutz, I would talk about how infants who have been raised on a kibbutz generally turn out. I also use textbooks, which have strengths similar to those of lectures but can cover a still larger range of fact and theory. Textbooks often provide general background and factual tie-ins for the films as well. Finally, I have the students observe children in order to test some facts and theories for themselves, to experience the methods from which facts are derived in the field and to become personally involved in the material.

Thus, each medium — video or film, face-to-face communication, print, and real-world observation — contributes a unique point of view on a common set of topics. Together they provide memorability, active learning, factual content, and generalizations about the field. While this example is simply based on my personal experience, it agrees with the facts that have been accumulating about each medium and about the value of multimedia learning.

THE SECOND advantage of multimedia education is that it can foster new skills that print alone cannot. As Gavriel Salomon's research shows, television and film viewing, even home viewing, develops visual abilities, such as skill in imagining how a scene would look from another point of view.

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This ability to shift visual points of view is required to interpret different camera angles often used in filming or televising a scene. This visual skill is part of what can be called television or film "literacy." Arcade-style video games add further development to visual-spatial skills like these, as research by Diana Gagnon at Harvard shows.

Contrary to what many people might think, the development of visual-spatial skills such as this one has important implications for education. In a 1977 article in *Science,* E. S. Ferguson pointed out that the language of technology is basically a nonverbal one and that people involved in technology need to be able to think in terms of visual images, not just numbers. Ferguson's point is even more important today, when so much engineering and other kinds of design are done on a computer screen. Indeed, research shows that computer skills of all sorts, from word processing to programming, depend on good visual-spatial skills. In education, our standardized tests rarely measure these skills. Yet all indications are that they will be increasingly important in the world of tomorrow.

Our research shows that video games develop still other skills of educational value; for example, the discovery processes that are so important to scientific thinking. This effect stems from the fact that video games are likelife: No one tells you the rules in advance; you must figure them out for yourself through observation, trial and error, and the process of hypothesis testing — in other words, the essence of the scientific method. Video games are thus an informal learning mechanism that helps to develop the scientific thinker who is able to approach complex systems with unknown rules and figure them out, just as a video player figures out the game. Video games also introduce children to the world of microcomputers at a time when computers are becoming increasingly important both in many jobs and in daily life.

THE THIRD important reason for multimedia education is that it gives us educators the chance to greatly boost each medium's educational value. The growing pervasiveness of television, video games, and other computer technology makes it all the more urgent that we discover how best to use them. We know that the educational impact of a medium is enhanced

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when it becomes the subject of dialogue and discussion, and school is the setting where such discussion can most easily take place. It is important to point out that print literacy (reading and writing) has become "educational" not because of the intrinsic qualities of the medium but because print is used in formal education. That is, in the schooling process, what children read is made the subject of discussion and analysis, and students are made responsible for mastering its content. These same educational processes of discussion, analysis, and mastery can and should be applied to any and all media, not just the printed word and the word spoken by the teacher.

The importance of subjecting all media to analysis and critical discussion attests to the key role of the teacher. No medium can replace the teacher; each medium simply adds to his or her store of professional tools. The active, guiding role of the teacher is essential in countering the passivity and other negatives typically associated with some forms of electronic media.

Video recorders and videodiscs are an important development in making it possible for the visual media to be the object of critical reflection. Not only do they allow broadcast television to be fit into classroom time slots, but a bit of tape can be viewed again or slowed down for the sort of active analysis that a few lines of poetry or other literature can be subjected to.

Video recorders make it possible to use television in many ways that books are now used. Parents can assemble selective videotape libraries for children's use at home. School libraries need to have video players and collections of videocassettes so that teachers will be able to assign viewing as they now assign reading for later discussion in class. This is particularly important for film as literature, because feature films are often too long to be shown in class.

TEACHERS MUST not only use the media to teach, they must also teach about the media. Teachers have great potential for influencing the child's perception of and response to different media. For example, curricula organized around televison can give children a more sophisticated and critical approach to viewing at home. Because children watch so much television out of school, the school needs to exert an influence to maximize the benefit and minimize the harm that results from socialization by the "tube."

Indeed, teachers can have a strong influence on what children watch in their homes. In the research on "Freestyle," a PBS program designed to counter sex and ethnic stereotypes about careers, teachers in a number of different cities reminded one group of students to watch the show at home. This teacher guidance produced a rate of home viewing almost seven times higher than the national norm for the program.

Indeed, the school may be the most practical way to influence the way children watch TV and what they watch. Comparing school and home as sources of guidance for children's television viewing, Dorothy and Jerome Singer found that it was easier to influence what children watch on TV and how they watch it by working through the schools than by working through parents. I can think of a number of reasons why it would be difficult to work through parents. Most parents work, and this is probably all the more true for the parents of children who watch large quantities of television. Parents who work and tend to need television as an electronic babysitter are just the ones who probably lack the time and energy to educate their children about television. In general, parents are often at a disadvantage relative to teachers in the time, energy, and knowledge necessary to guide their children's TV watching.

This is certainly not to discourage parents from guiding their children's television viewing. They should do all they possibly can. It is to say that their task can be helped by teachers. Parents are generally in a better position to know what they do *not* want their children to watch than what they do. It is in making positive suggestions that teachers can be most important.

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Making a television show the focus of interaction with an adult enhances children's learning from that show. One important reason for this is that such interaction makes children realize that mental effort is expected of them. Israeli researcher Gavriel Salomon finds that children tend to approach television as an "easy" medium, spend little mental energy on watching it, and, therefore, learn rather superficially from it. In contrast, they view reading as more difficult, invest more mental effort, and learn more deeply from it. However, if children are told to look carefully and try to learn from television, the depth of learning becomes greater. Television viewing comes to resemble reading in this respect. If television were part of school assignments, teachers would very naturally give just this type of instructional message. Why not, for example, assign TV reports to get children to watch and analyze more challenging programs, just as teachers now assign book reports to get children to read and think about books that they might not otherwise know?

A further step in this direction is to treat television as a serious object of study. Rosemary Lehman does this in the elementary school curriculum she designed around the formal features of television, the medium's code and aesthetics. As a class in English literature might talk about the techniques and style of Shakespeare and Dickens, children in Lehmans' program talk about the tech-

niques and style of television programs.

Lehman's curriculum was tested for a school year with eight-and nine-year-old children. These children were compared at the end of the year with another class taught by the same teacher without the television curriculum. At the end of the year, the children who had studied the forms and aesthetics of television were conscious of stylistic features such as color and composition; children in the other group were limited to conscious awareness of story line.

In addition to increased awareness of the forms of television, the year of studying television also caused a shift in the children's television-viewing tastes; action-adventure and formula programs dropped from their lists of favorite shows and were replaced by more challenging programs. No such change took place in the other class. For example, among the children who had studied television, "Charlie's Angels" dropped from first to tenth place; it was replaced by the evening movies. Whereas no documentaries or docudramas were on the list of favorites before the course, "Holocaust" appeared in the top ten afterwards.

ANOTHER APPROACH to teaching about television focuses on turning children into critical viewers. These curricula aim to counteract the bad effect of U.S. commercial television rather than to use television in a positive way. Camera techniques tend to be treated as devices for deception rather than for art. In fact, the techniques have both sides to them. The critical skills type of curriculum does, however, contribute to children's awareness of the medium. Both approaches to the study of television have distinctive contributions to make, and children would benefit from being exposed to both approaches in elementary school.

Another way of using television in the schools, one that has become increasingly common in the United States in recent years, is to read television scripts in the classroom. The television networks now release their scripts in advance; CBS distributes millions of scripts and coordinated teacher's guides and student workbooks. Teachers in Philadelphia who used scripts from television programs reported improved reading scores and much more interest in reading. Scripts were even stolen from the classroom, the first known theft of reading material in that school.

THE FOURTH argument for multimedia education is that it allows children with different learning styles and backgrounds to be accommodated. A child who lacks a high level of print literacy, for example, may have good facility with computers. Research by Dina Feitelson indicates that children who have not been read to at home before they come to school are at a disadvantage in developing reading comprehension skills. Yet in the United States, such children have become familiar with the television medium at home and are not at a disadvantage in learning from video. Bringing the electronic media into the schools could take advantage of the strong attraction that these media hold for children. I think that it would also make education seem more tied to the "real world," where the importance of the electronic media relative to print is probably the reverse of their relative importance in the world of the school.

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Many parents and teachers might worry that spending time with video media in the classroom could further erode reading and writing skills. However, they can also help build print literacy skills. For example, they can be used to enhance the comprehension and enjoyment of literature, especially on the part of less-able students. Working with junior high school students, Elias Levinson looked at how their response to short stories (by authors such as O. Henry) differed depending on the medium of presentation. One group of students read the original story, another group both read the story and saw it on film. The results showed that the addition of the film very much increased comprehension and enjoyment of the stories, especially for students with lower I.Q.s. The advantage added by the film was also greater for the more unfamiliar stories, indicating that film or television could be particularly valuable for unfamiliar subjects or genres.

It is interesting that the films stimulated not only comprehension and memory of the story but also a desire to read more, similar stories. In recognition of this, the Library of Congress has recently announced a new program to "emphasize the importance of linking the pleasure, power, and excitement of books and television." Beginning in September, with the screening of a new series of "Shelley Duvall's Tall Tales" on the Showtime cable network, the actress-producer will appear on the screen at the end of each production and suggest that viewers who have *watched* a good book may also enjoy *reading* a similar one, naming several books recommended from lists supplied by the Children's Literature Center of the Library of Congress. It is also important to note that the effect of film on reading is greatest for the children who tend to have more problems in school, that is, the low I.Q. group.

For all these reasons, teachers need to move toward a system of multimedia education in which the electronic technologies of audio, video, and computers will surely play a key role. Properly used, every medium, without exception, can provide opportunities for human learning and development. Our challenge now is to discover how to make the best use of all media, so that every form of communication and learning can be employed to create the most effective education system possible. □