Learning Technology Comes of Age

Computers, interactive television and simulators may create a new era for education and even help solve pressing social problems, but serious doubts remain

BY JOHN H. DOUGLAS

CDC

Student nurse uses PLATO to "dry lab" an experiment through computer simulation.

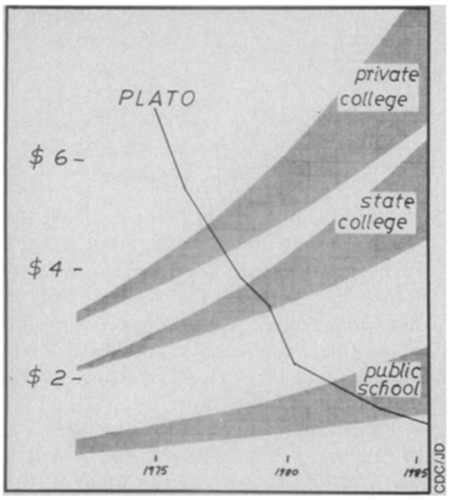
At 10 p.m. I was suddenly left with an unconscious patient, male, roughly 55. His hands were cold, face pale, pulse regular and rapid. No medical history, no idea how long he had been lying on the street before being brought in. I took his blood pressure—dangerously low. Then I hesitated. I'm a science writer, not a doctor, what the hell am I doing here? Too late now; I struggle to remember which of the vaguely familiar drugs go with which symptoms. Digitalis sounds right, but how much? Try a little. He gets a *little* better.

O.K., I've got him stabilized, now what? Blood tests. The pH looks funny, but I can't recall the extremes of normal range. Is this when you use intravenous sodium bicarb? I've wasted too much time; it's 1:15 a.m., and his heart is due to stop. I've let him die!

I sat there with sweating palms. My feeling of helplessness was devastatingly real—fortunately the patient was not. I was sitting in one of the quiet, dimly lit "learning centers" the Control Data Corporation is opening around the country to commercialize its PLATO computer education network. After an hour or so of playing computerized games for elementary school kids and taking a lesson from a master's level course in accounting, I had asked for something "real"—and I got it.

My simulated patient, never more than a table of figures on the glowing output screen, had become real enough—with his detailed reactions to my every operation or moment of hesitancy—that he brought flooding back all the repressed memories of a small boy I had tried to save after a bicycle accident, who had died in my arms. Obviously a case of advanced heart disease was intended for more competent hands than mine, but the experience clearly dramatized the flexibility and power of an exciting new medium of instruction.

Such simulation is only one of several revolutionary educational innovations made possible by new technology. Only a few days earlier, the Grumman Aerospace people had graciously let me "crash" a fighter plane, during a "hands on" simulation involving a one-half scale cockpit replica folded out of a suitcase. (It seems I went down in flames after responding incorrectly to a "Fire Warning" light). These, and simpler systems designed ultimately for home use, promise



Projected costs per student contact hour for computer vs. conventional teaching.

to change the way Americans think about education. But several hurdles must be overcome before the new "learning technologies" are used by a majority of teachers and students, and serious questions remain concerning their ultimate impact on society.

Two strong forces seem likely to drive the mobilization of technology to address educational needs: a widely held feeling among many parents that America's schools are a mess, and the conviction in industry that learning technology has matured enough to meet the challenge.

Public education has borne more than its share of upheaval during the social changes of the late 1960s and early 1970s. Educational emphasis has swung from trying to produce more engineers than the Russians, to presenting material "relevant" to a society in flux, to fulfilling the demand for "practical" training in a tight job market. A declining birth rate has left many classrooms empty, many problems arising from busing and integration remain unsolved, costs have skyrocketed despite a serious recession, and the need for more adult education has become more apparent, if not more tractable.

To each of these problems the supporters of learning technology say they have at least partial answers. While the costs of conventional education have risen, those of electronic education are falling steadily. If computer instruction or educational television programs were supplied evenly throughout a school system, some claim, there would be no excuse for one school to be poorer than another, and busing would not be necessary. As curriculum needs continue to change, it is argued, technology would prove more flexible than bureaucracy, permitting almost instant reprogramming to meet changing demands. Most important, the technologists point out, most of the new systems are geared toward individualized instruction, with each student able to proceed at his or her own pace.

"Educational technology has been all but forgotten by schools struggling against imminent bankruptcy," says Robert G. Scanlon, executive director of Research for Better Schools, Inc., of Philadelphia. Yet technology "has given us the opportunity to significantly improve the education of the culturally and economically deprived child and the child who is regionally isolated from the mainstream. It has given us new management systems, new and more effective ways of training teachers, and new and more effective educational materials."

Certainly educational technology has scored some spectacular successes in some of the areas where it is already competing with traditional teaching methods. When PLATO was used to teach introductory accounting at the University of Illinois (where the system was originally developed), a side by side comparison with conventional instruction showed that the students using the computerized course learned their material in 40 percent less time and scored 10 percent better on the final examination. Similar results have been reported elsewhere, though it is not yet clear how much of this improvement is due inherently to use of computers and how much stems from material that has been more carefully organized than that of many university instructors.

The armed services have also been among the first heavy users of instructional technology, because of the high value placed on saving time (students are paid full salary while in training) and because of the expense and danger of on-the-job training (a pilot in a real plane would not have lived to go to lunch, as I did). For many of the same reasons, industrial training has also proved a successful market. Crisis simulation on actual equipment, say for a nuclear reactor operator, may be unthinkable, yet being able to respond well in an emergency may avert a major disaster.

The degree of sophistication achieved in imitating such real-life situations can be seen in a model oil refinery developed by the simulation products division of Singer. With a computer-driven control room and a scaled-down functional plant the size of a warehouse, the simulator can train an operator how to handle some 50 automatic process control loops and 40 different malfunctions.

The ultimate market for educational technology, however, is an electronic learning center in the home. One of the leading experimental projects for bringing education to the home also demonstrates the potential of technology to help the handicapped. The TICCIT computer education system can be used wherever there is cable television. Developed by the Mitre Corp. of McLean, Va., and scheduled for commercialization this fall by the Hazeltine Corp. of Greenlawn, N.Y., TICCIT requires only an ordinary color TV set, to which a small keyboard is added, rather than the special display unit required by PLATO. A publicly subsidized project began last year in Amherst, N.Y., to bring a variety of courses to homebound handicapped children, via TICCIT.

Though TICCIT and PLATO are nominally competitors, John L. Volk, who heads the computer system department at Mitre, told SCIENCE NEWS he sees the Control Data effort as helping to establish a market in which there is plenty of room for both systems. He looks toward the day when programs and lessons are made compatible on both systems. For the moment, the major differences are that PLATO depends on large, remote computers that have greater flexibility but involve more expensive communications cost. TICCIT is operated locally by a minicomputer, which can handle 128 terminals, and the system can be integrated with videodisks when these become available.

Despite the obvious potentials and outstanding successes of some learning technology programs, the costs remain staggering, and whether the promise of nationwide computer-television networks for community and home learning centers becomes a reality depends on many social and economic factors that can now be only dimly perceived.

This is not the first time industry has rushed in to show educators how to run their business, and incidentally reap a profit. Over the last decade, several major companies have ventured into the learning technology market, with everything from programmed-instruction textbooks to audio-taped science courses that assumed virtual illiteracy on the part of college freshmen. Most of these ventures rapidly proved to be more expensive and less profitable than their designers anticipated, and a few led to well-deserved financial disasters. The difficulty, says Raymond G.

Continued on page 174

. . . Learning

Fox, the IBM engineer who is president of the Society for Applied Learning Technology, was that ten years ago industrialists thought they had a solution and went out expecting to solve educators' problems. Now, he says, companies realize they must work with educators from the start, and seek a solution together. (For his own part, Fox has been active in an IBM project to develop learning technology for the deaf.)

Even where engineers and teachers have cooperated, however, their task has proven difficult and expensive. Just to program PLATO to teach the University of Illinois accounting course, for example, required 15,000 man-hours. The cost for teaching the course by conventional means was reported to be $1.35 per student contact hour (a figure others claim is way too low), while the PLATO course cost between $3 and $5 an hour. The commercial PLATO rate charged at the Control Data learning centers is $12 an hour.

Industry spokesmen reply that the costs of this and other programs are so high because they are still in the developing stage. They point to the plunging price of electronic calculators and watches and predict the same phenomenal growth for computerized instruction and videodisks. The cost of PLATO services, for example, is predicted to fall to one-third its present rate in just five years (see chart). And a good indication that Control Data actually believes such figures is that the company is committed to making the biggest investment in its history to commercialization of the project—an expected $60 million over the next decade.

If the financial benefits of learning technology remain uncertain, the educational and social arguments over automated teaching are even further from resolution. The National Science Foundation is sponsoring computer-based education (CBE) projects involving both PLATO and TICCIT, and the man in charge of program integration, Alphonse Buccino, remains somewhat skeptical. While emphasizing that he was speaking for himself and not as an NSF official, Buccino told SCIENCE NEWS that although the advantages of sophisticated computer simulation are clear for high-level, professional areas such as medicine or industrial training, the benefits of substituting gadgets for conventional teaching in public education at all levels remain to be demonstrated.

He cites three particular difficulties: The interaction of a teacher and a class should be spontaneous, people have a natural resistance to machines, and the new technology may wind up benefiting the advantaged child more than the disadvantaged. (He points out that the television program Sesame Street, though equally available to all children, apparently helped the advantaged children more [SN: 3/24/73, p. 183].)

To officially evaluate its programs, NSF has hired the Educational Testing Service of Princeton, N.J., to determine what educational benefits learning technology has over conventional methods. (The study was originally to investigate cost benefits and compare the technologies involved, as well, but these phases were eventually abandoned.) Donald L. Alderman, a research psychologist at ETS, told SCIENCE NEWS that the analysis of data from the projects is incomplete and will be published sometime this winter, but he seems to share much of Buccino's skepticism. In one PLATO-taught English course, he said, students performed only marginally better than those using conventional methods. Students completing a math course using TICCIT showed superior performance, but the number of students who actually finished the course dropped. He did not agree that the gap between advantaged and disadvantaged students is likely to be widened by learning technology, but he cautioned that when students are given a "self-paced" course, the brighter ones do tend to speed up while the slower tend to lag even more.

Perhaps the most articulate response to such criticisms of the social and educational impact of learning technology comes from Richard A. Avner, chief of the education evaluation and research group of the Computer-Based Education Research Laboratory at the University of Illinois. His group has been concentrating on how to strike a balance between technological and conventional teaching methods and how to increase acceptance and beneficial impact. Like Buccino and Alderman, he says CBE has already proven financially and educationally effective in professional schools, and he admits that its value in undergraduate education now depends on individual circumstances. But the problems of elementary and high schools, he insists, can be greatly helped by an infusion of learning technology. The key point is how the technology is integrated into the teacher-pupil relationship.

One example of appropriate integration, Avner says, is through games. Assuming that schools are largely for socializing as well as learning, why not introduce simulation games in which the children learn to cooperate in solving an external problem? Schools today place too much emphasis on competition, he says, and rather than dehumanizing students or widening existing gaps between them, computers and other learning devices can help foster a "Navaho approach to life"—in which cooperation comes before competition.

Leaving theoretical considerations aside for the moment, a recent incident in Baltimore dramatizes both the potential of learning technology for promoting social change and the probability that students will prove more adaptable to automated education than their elders. As reported by Patricia Fanning in the May 8 National Observer, teachers at an inner city high school discovered that their students had carefully jimmied a heavy, steel mesh panel in the door to the computer learning center and were sneaking in after hours to practice. The principal of the school, which is set in the midst of a black neighborhood, says that PLATO-taught math is the hottest thing going and that the pupils now come back after school to work on the computer terminals as long as the building is kept open.

Adults with learning deficiencies also do not seem particular about whether they must turn to machines for help. The University of Mid-America is a consortium of seven state universities in five Midwestern states that acts as the central agency for a major program of educational outreach based on learning technology. Using a variety of media, from television broadcasts to newspaper articles, UMA reaches an audience virtually untouched by campus-centered education. The median age is 37, a majority of students are women, one-third live on farms or ranches, and half have no previous college experience. Though some courses are geared for general cultural "enrichment," roughly two-thirds of the students in the program are using it to pursue a degree.

Similar programs are being introduced around the world. PLATO has been extended to Iran. The world's largest all-correspondence school is now the University of South Africa, with an enrollment of 35,000 students. (The university uses radio to offer courses to villagers in remote areas—a favorite technique in many developing countries.) Rural areas in the United States are being reached by a new program involving the Applications Technology Satellite—last summer some 1,200 teachers in Appalachia received in-service training through television programs broadcast by the satellite. Even the "prestige" universities are beginning to see advantages in learning technology; Stanford, for example, gives its course in Old Church Russian by computer because the number of students enrolled does not warrant hiring a full-time instructor.

A realization of just how powerful these new tools can be inevitably creeps in as one sits at a computer terminal learning about accounting or playing a game based on the Star Trek television series. On the one hand there is a natural feeling of frustration when faced with a teacher, or game adversary, whose only intimation of mortality is an occasional blink. On the other, there is the reassurance of having an infinitely patient instructor and a non-competitive environment, where the only object is to learn, no matter how long it takes. The thrill of accomplishment is just as satisfying once a problem is solved and the panel lights up "RIGHT ON!" □