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How Much Bang for the Buck?: Teaching Computer Systems Faces a Test

Teaching Computer System Faces a Test

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The student becomes a bird in search of food. Moths flit and swirl in front of him. Light ones and dark ones land in random positions among the leaves of pollution-darkened trees. He eats his fill, finding after several forays that he is devouring most of the light-colored moths but is finding few of the dark ones, which blend into the darkened foliage.

He eats his way through several generations of moths and finds, after several cycles, that fewer and fewer moths are being hatched light. The moth population is changing genetically; and he is either going to have to change his eating habits, learn to find dark moths on dark trees or move on to another area. The student has learned something important about ecology, population genetics and evolution. He knows how a pollution-caused change in the color of foliage, for example, can affect the living system of which it is a part.

On another, perhaps more advanced level, a medical student is presented a patient. He performs a diagnosis and prescribes a course of treatment. If he is right, his patient recovers. If he is wrong, he is likely to be confronted not only with an uncured patient but with an array of treatment-caused complications which he must also interpret. He, too, has learned something important.

A Single Computer

In each of these cases, and in others like them, in subjects ranging from elementary school Spanish to advanced theoretical physics, the students are being taught simultaneously by a single, highly sophisticated, computer-linked instructional system called PLATO, for Programmed Logic Applied to Teaching Operations.

PLATO is now nearing the end of more than a decade of research and development at the University of Illinois at Urbana-Champaign. It is the hope of its developers, a team headed by Prof. Donald L. Bitzer, that it will prove both economical and effective for far more than the self-paced rote learning and drill to which skeptics traditionally limit computer-based educational systems. In fact, says Bitzer, the notion that "computer instruction may be useful for the transfer of information but is not of value in the development of critical thinking," is high on the list of misconceptions PLATO is expected to dispel. Bitzer feels, as do others, that computers in education, through the instant feedback, individualized instruction, automatic monitoring of progress and increased personal attention from the teacher they make possible, offer effective treatment for many of the problems confronting contemporary education.

PLATO, with support from the National Science Foundation, the Department of Defense and the U.S. Office of Education, has gone through three generations since its inception in 1959. Now, as PLATO IV, it is coming out of the laboratory, headed ultimately, Bitzer hopes, for simultaneous use by some 4,000 elementary and secondary school and university students in 150-mile rad-

ius of Urbana-Champaign by the time it is in full operation—tentatively, 1978.

Began in 1959

Bitzer and his co-workers began in 1959, with a primitive computer program called PLATO I, able to provide instruction for a single student console.

PLATO II could serve a pair, thereby proving that a single computer could instruct two students at one time.

PLATO III, using a medium scale digital computer, has been providing effective and reasonably reliable instruction via 20 student consoles simultaneously for several years. In that time it has enabled its designers to develop considerable insight to the requirements and capabilities of this method of instruction, in classrooms at the Univeresity of Illinois, at a nearby community college, in a public school and at a school of nursing. PLATO III, however, has had to depend on television tubes for console screens. These required costly television-quality cable or microwave links to the computer, as well as extra computer capability hold images on the screens.

Uses Phone Lines

Those handicaps were overcome by the invention of the PLATO IV device: a display panel which can operate with an ordinary telephone line connection to the computer and holds down demands on the computer by retaining displayed images. It is composed of two sheets of glass, slightly separated, with a gas trapped between them. Transparent, electrically-conductive strips on the glass excite bright pinpoints of light in the gas in selected areas. These closely spaced points of light form words, numbers and diagrams on command of either the student or the computer program.

Also under computer control, any one of 256 images from a four-inch square "lesson" slide inserted by the student may be projected onto the back of the panel to combine with the computer-generated display. In addition, for subjects such as languages, there are computer-controlled audio devices: sound discs carrying up to 4,000 messages each.

In addition, Bitzer has developed a technique for "riding piggy back" upon the message-carrying capabilities of the educational television networks so that thousands of students over a wide radius can use simultaneously the capabilities of a central, time-sharing computer.

Cost-Effectiveness

Bitzer certainly, but many of his colleagues as well, believe that PLATO, in the years since its inception, has made headway in the cost effectiveness race all such systems are being required to run. Furthermore, it is being widely conceded that the innovations which have enabled Bitzer to bring costs down for PLATO will ultimately reduce costs for computer-assisted instruction generally.

Simply making a contribution to computer-based educational technology, however, is not what Bitzer and his colleagues are after. They are designing and programming a system which they hope to see adopted by school systems

all over the country. And for this, economy and reliability alone are not enough. Teachers, school boards, planners and parents must be convinced that CAI can provide effective education at the classroom level. Unfortunately, educational effectiveness is difficult to define, let alone measure and compare. According to Erik McWilliams, director of the National Science Foundation program presently supporting PLATO, "there is considerable disagreement and uncertainty concerning how best to measure educational effectiveness. Certainly rate of progress, depth of penetration, retention and other widely-accepted factors are important, but what about student motivation, performance outside of the CAI classroom, and the like?"

Some answers should be forthcoming; the foundation is planning to initiate, early in 1972, several large-scale tests of various computer-based learning systems, including PLATO IV. Current plans call for data collection in actual classroom settings to begin in the 1973-74 school year. This will form the basis for a later cost-benefit evaluation by an independent group.

A Confident Scientist

Neither NSF officials who are sponsoring the tests nor other computer-education specialists will forecast results of the trials. Bitzer, however, having devoted more than a decade to PLATO, believes that he can predict its ultimate worth. "A single PLATO IV system," he wrote in the journal *Science* recently, "operating 10 hours a day could provide approximately 10 million student-contact hours annually at a cost of about $3 million to $4 million. . . . This is equivalent to the total annual number of hours of instruction (now costing $20 million a year) at a four-year undergraduate institution with 24,000 students!

"This comparison is obviously not meant to suggest that PLATO could be substituted for such an institution.

"Rather it is intended to indicate that a single PLATO IV system could augment by 20 percent the instructional capacity of five such institutions on an annual budget of less than $1 million each."

The added capacity a PLATO system would offer a college, Bitzer suggests, "could release an equivalent portion of faculty time for developing new programs, for teaching in smaller group settings or for providing extra help to individual students.

"The possibility of such enrichment of our national educational capability has provided added incentive for implementing and testing the PLATO IV design and for learning how such a system would function in various educational settings."

New Symbol of Excellence

And about computer-assisted instruction generally, he wrote: "The introduction of a major new technology into the educational process will undoubtedly raise questions on the part of some educators concerning the possible negative impact of an inanimate tutor on the very human processes of learning and teaching.

"Similar questions," he argues, "may well have been raised when the printing press and inexpensive paper were introduced into the educational process in the fifteenth century. It was not long, however, before the technology of the printed page became so identified with education that the library became the universal symbol of educational excellence.

"We believe that the resulting explosion of knowledge and of information has made the introduction of computer-based education all the more needed in a rapidly changing world."