

EXCLUSIVE SURVEY

How far have we come? What's just ahead?

Patrick Suppes, one of the leading CAI authorities in the country, tells how the science of the new technique has been developing and where it seems to be going

DR. SUPPES, WHAT DO YOU FEEL HAS BEEN THE MOST IMPORTANT DEVELOPMENT IN COMPUTER-ASSISTED INSTRUCTION DURING THE PAST FEW YEARS?

The important development is that a fair number of installations have become operational. In 1963-64, there were very small numbers of students being run in CAI systems; in 1968, a number of places have had a couple of years experience. We now have a large accumulated operational experience and a much more practical background of what the next five years will bring.

DOES THAT MEAN WE ARE WELL ALONG IN THE DEVELOPMENT OF CAI?

There are three stages of development. For the most part we are still in the first phase, but we are also moving into the second stage.

In the first stage we have the beginning of CAI in a serious operational sense — students being processed daily — organized around major research centers. We now have such experimental activities in a large number of centers: in the West, Stanford; Midwest, University of Illinois and the University of Michigan; South, University of Texas; Southwest, University of California at Irvine; Southeast, Florida State University; East Coast, Harvard University, State University of New York, and Pennsylvania State University.

In the second stage, we have

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demonstration efforts operated by school systems. There is no attempt here to reach the total school population — only small demonstration groups. We are just getting into this second stage now, and a large number of ESEA Title III proposals are being developed for this purpose. There are one or two very pertinent projects. For example, the New York City project is installing a large system for computer-assisted instruction in elementary mathematics, Grades 1-6, and it is under the supervision of the New York City schools. The New York demonstration is a large one — perhaps the largest demonstration within a school system — but other similar ones are now taking place within the context of school systems in a university research center.

In the third state, school systems attempt to make CAI an operational part of their regular school operation and have it reach every student of a given age level and in a given curriculum. I think it will be a couple of years yet before we reach this saturation stage in any area of the curriculum for any significant number of school systems.

ARE THERE ANY SCHOOL SYSTEMS CLOSE TO THIS THIRD STAGE?

McComb, Miss., will reach saturation this coming year. Of course it is a small system. It hopes to have every elementary student in Grades 1-6 at a terminal every day for some supplementary drill and practice in elementary mathematics. Each student will be there from five to ten minutes each day. That short period is a very intense pe-

riod of activity for the student. He will work on the average of 20 to 30 exercises in that period. The curriculum is at a highly individualized level of instruction.

I should mention that the McComb students are being assigned problems and are handled by the central computer in Stanford.

WHAT ARE SOME OF THE IMPORTANT LESSONS LEARNED FROM CAI EXPERIENCE TO DATE?

One lesson is that we have to be concerned about systems reliability and response time. In the initial operative phases of a CAI system, it's important to concentrate on these aspects.

HAS THERE BEEN A PROBLEM WITH SYSTEMS RESPONSE TIME?

Yes, and it's a very important problem to solve. Even a curriculum that is well prepared and organized from a technical standpoint will not function if the response time is very slow. The students wander away from the material.

WHAT CONSTITUTES A SHORT RESPONSE TIME?

For elementary students, the response time is a maximum of two seconds. For high school or college students it is more sensitive to the subject matter. In the case of foreign language training the two-second limitation still applies. In more complicated conceptual analyses on the part of the students — as in more advanced parts of mathematics or physics, the systems response time can be slower — a maximum of 10 seconds.

HAVE COMPUTER COMPANIES BEEN DEEPLY INVOLVED IN CAI RESEARCH?

Only to a medium degree. Most of the CAI curriculum has been developed under government grants through academic research centers. Some of it comes from nonprofit organizations. Research by computer



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companies is reflected primarily in the development of computers for this application.

Computer companies on the whole are just beginning to make commitments to CAI.

Universities have been doing a good part of the research. Most of the money has come from the U.S. office of Education and the National Science Foundation. These will continue to be the main sources of funds.

WILL DRILL AND PRACTICE BE THE MAJOR INSTRUCTIONAL MODE USED IN CAI IN THE NEXT FIVE YEARS?

Probably yes — and in the five years following that, probably no. As time goes on, with the cheaper cost of computers, we will be able to have a much richer tutorial interaction between the student and the computer program. As for terminals, we'll probably be using

mostly teletype and typewriter stations for the next five years for the simple reason of economics.

HOW ARE INSTRUCTIONAL PROGRAMS COMING ALONG? IS TECHNOLOGY OUT-RUNNING THE SOFTWARE?

We probably need curriculum development, but that's not the worry at present. Developing CAI is really a three-cornered affair: technology, economics, and curriculum. The real problem is money.

WHAT ABOUT COSTS? ARE THEY GOING DOWN? WHAT IS THE FUTURE?

There are three main elements in CAI costs (1) central processing computer units, (2) communications and (3) terminals.

The first is going down nicely. Cost of computers and large scale memory will be very good in a very few years. It is not likely that communications and terminal costs will show a corresponding decrease.

WHAT IS A GOOD COST?

In supplementary drill and practice programs in the elementary school, one would like to have costs at \$25 per student per year for the total CAI program. For a self-contained course in a foreign language at a university level requiring only nominal faculty supervision, we might well accept costs of \$200 or \$300 per student per year.

WHERE ARE WE NOW WITH COST?

Without much effort we could offer the drill and practice for about twice the figure I named, and could offer the foreign language for about twice that figure too. I should add these may be slightly optimistic figures.

DO YOU FORESEE THE DEVELOPMENT OF NATIONWIDE CAI NETWORKS?

I don't see a necessity for them. If you talk about the experimental stage, networks are useful because they permit the technology to be brought to places much sooner

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What students think about CAI technics

Teachers and administrators may be excited about computer-assisted instruction, but what about students? What do they think about it?

In some just-completed IBM research on this question, a group of 138 students (89 high school students; 49 college students) was scheduled to work at CAI terminals for daily periods of 50 and 100 minutes — corresponding to normal classroom lecture periods. The equipment used was the IBM 1500 instructional system; student terminals were equipped with a television-type screen, a keyboard resembling a typewriter, and a light pen.

The course covered theories of data processing, including organization of a computer, data storage, and computer programing.

Here's what the study disclosed about CAI students:

— They seemed to work faster. Students paced themselves through the course; completion times averaged about 22.5 hours. Under the classroom lecture method, observers felt the same course material would normally be covered in 30 hours.

— They did five per cent better on the final exam than a control group of 85 professional engineers who were conventionally trained.

— Eighty-eight per cent found CAI enjoyable and said it held their interest throughout the course. Only nine per cent felt it monotonous, mechanical or impersonal. One per cent found their concentration adversely affected by difficulties encountered in operating the terminal itself.

— Eighty-four per cent found the conversational format pleasing.

— All thought the presence of a proctor contributed in varying degrees to the successful completion of the course.

— They felt CAI could optimally provide about 43 per cent of a course's content. — HARVEY S. LONG, *Instructional Systems Consultant*, SUZANNE MURPHY, *CAI Coordinator*, WAYNE WENGERT, *Research Programmer*, IBM Systems Research Institute, N.Y., N.Y.

than it might. For example: McComb, Miss. But when we get to the operating school level, it seems to be more doubtful, mainly because of the size. We would not be able to put on one computer all the students within 20 miles.

WHAT ARE THE MOST IMPORTANT CHANGES IN EDUCATION THAT CAI WILL MAKE IN THE NEXT FIVE YEARS?

I will restrict my answer to two predictions:

We will make individualization of instruction in the elementary school more of an operational fact in two important areas of curriculum — reading and mathematics.

We will see use of CAI growing in junior colleges and community colleges because of the many problems faced in adequately staffing these colleges.

HOW WIDESPREAD DO YOU THINK

CAI WILL BE IN THE K-12 SPECTRUM?

In five years, we can anticipate that between 200,000 and 800,000 students will receive this kind of instruction daily throughout the country, and in ten years that number could be between one and 10 million.

DO YOU FEEL THAT THE DEVELOPMENT AND APPLICATION OF CAI AS AN INNOVATION IN EDUCATION IS PROCEEDING SMOOTHLY OR ROUGHLY?

I would not want to say necessarily smoothly. It is a complicated technology both from educational and computer standpoints.

There is certainly a shortage of funds for the development at present, and probably it will be this way for a while. Certainly there are great pressures for the field to continue to develop, but it will be a complicated history of development. ≠