

18. The Teacher and Computer-assisted Instruction

EDUCATORS HAVE SHOWN increasing interest in the use of computers for classroom teaching, especially during the last year or two, and they have raised a number of fundamental questions that need analysis and discussion. The purpose of this article is to acquaint the reader with some of the ways that computers can be used for instruction, and to answer, at least briefly, some of the questions that are frequently asked about computer-assisted teaching.

Some of the most important questions are: How can the computer help in individualizing instruction? How might it change the teacher's role? How will computer-assisted instruction change teacher-administrator relationships? Will it lead to impersonality and regimentation in the classroom? How can teachers play a part in planning and using computers for instructional purposes?

Let us begin by looking at a student seated at a console or station that is connected by a telephone line to a central computer. The console will usually contain a typewriter keyboard that the student can use to "talk to" the computer and a television screen that can display written messages as well as drawings, equations, and other graphic material. In many cases, the student will also have a "light pen," which he can use to select answers to the problems shown on the screen; he can even erase or change the images that appear. The computer talks to the student through a pair of earphones or a loudspeaker, thus providing him with the verbal communication necessary for effective learning, particularly when new concepts are being presented.

The central computer, which controls the presentation of information and evaluates the students' responses, need not be in the school but can be located

at a central point in the school district. Because of its great operating speed, one large computer can serve many students, and a number of students can “time-share” the computer simultaneously.

Computer-assisted instruction is possible with only one console per classroom, which would be shared by many students during the school day. In a more expensive and elaborate arrangement, a classroom would have a large number of consoles, and each student could spend considerable time—as much as an hour and a half a day—at the console. It is important to emphasize, however, that in either arrangement the student would still be spending most of his time in the regular class setting, directly under teacher supervision.

Recent research indicates that students at all age levels come to feel at home with this sort of equipment and are quite willing to make its use a part of their daily school experience.

The student and the computer program may interact at three distinct levels, each of which comprises a particular system of instruction. (This use of the word *system* also corresponds to its use in the computer industry.)

Individualized drill-and-practice systems. This kind of interaction between the student and the computer program is meant to supplement the regular teaching process. After the teacher has introduced new concepts and ideas in the standard fashion, the computer provides regular review and practice of basic concepts and skills. In elementary school mathematics, for example, each student would receive 15 or 20 exercises a day. These would be automatically presented, evaluated, and scored by the computer program without any effort by the classroom teacher.

In addition, these exercises can be presented to the student on an individualized basis, with the brighter children receiving harder-than-average exercises, and the slower children receiving easier problems. One important aspect of this individualization should be emphasized: In the drill-and-practice computer system, a student need not be placed on a track at the start of school in the fall and held there the entire year. At the beginning of each new concept block—whether in mathematics or in language arts—a student can be “recalibrated” if the results indicate that he is now capable of handling more advanced material.

Drill-and-practice work is particularly suitable for the skill subjects that make up a good part of our curriculum. Elementary mathematics, reading, and aspects of the language arts, such as spelling, elementary science, and beginning work in a foreign language, benefit from standardized and regularly presented drill-and-practice exercises.

Tutorial systems. In contrast to the individualized drill-and-practice systems, tutorial systems take over the main responsibility for helping the student to understand a concept and develop skill in using it. Basic concepts,

such as addition or subtraction of numbers, can be introduced by the computer program in such systems. The aim is to approximate the interaction a patient tutor would have with an individual student.

In the tutorial programs in reading and elementary mathematics that we have been working with at Stanford University for the past three years, we have tried hard to avoid having slower children experience any initial failures. On the other hand, the program has enough flexibility to avoid boring the brighter children with too many repetitive exercises. As soon as the child shows that he has a clear understanding of a concept by successfully working a number of exercises, he is immediately introduced to a new concept and new exercises.

Dialogue systems. Dialogue systems are computer programs and consoles that enable the student to conduct a genuine dialogue with the computer. It will be some years before we are able to implement dialogue systems in classrooms, because a number of technical problems remain unsolved. One problem is the difficulty of devising a computer that can "understand" oral communication, especially that of young children. We would like to have a computer that would respond to questions. To attain this interaction, the computer would have to recognize the speech of the student and to comprehend the meaning of the question. It will be some time before a computer is developed that will be able to do either of these with any efficiency and economy.

Dialogue systems have been mentioned here in order to give readers an idea of the depth of interaction we ultimately hope for. Drill-and-practice systems and tutorial systems, on the other hand, are already in operation on an experimental basis and will no doubt find an increasing application throughout the country in the next few years.

Effective programs of computer-assisted instruction now exist for elementary school mathematics, parts of language arts programs (particularly reading and spelling), and various topics in mathematics and science at the secondary and university levels. The programs have been developed primarily at universities, the following of which are currently the main centers of activity: Stanford, Illinois, Michigan, Texas, Pennsylvania State, Pittsburgh, Florida State, and the Los Angeles campus and the Irvine campus of the University of California.

Let us now look at some of the most frequently asked questions about computer-assisted instruction:

What role can computers play in individualizing instruction? The theme of individualized instruction has been prominent in American education for over 50 years. Psychologists have shown that individuals differ in their abilities, their rates of learning, and often even in their general approaches to learning. Unfortunately, the cost of providing individualized instruction that adapts to

these differences is prohibitive if it depends on the use of professional teachers. For example, consider what it would cost to reduce present classroom size to four or five students per teacher.

The computer offers perhaps the most practical hope for a program of individualized instruction under the supervision of a single teacher in a classroom of 25 to 35 students. The basis for this practical hope is the rapid operation of the computer, which enables it to deal on an individual basis with a number of students simultaneously and thus lowers the cost per student of the computer.

How will the computer change the teacher's role? Drill-and-practice systems will modify the teacher's role only slightly. What they will do is relieve teachers of some of the burden of preparing and correcting large numbers of individualized drill-and-practice exercises in basic concepts and skills and of recording grades.

The teacher will be more significantly affected by tutorial system. Let us consider a concrete example: teaching addition and subtraction of fractions at the fourth grade level. The computer will provide the basic ideas and the procedure of how to add and subtract the fractions. The program will probably be written so that if a student does not understand the basic concepts on first presentation he will receive a second and possibly even a third exposure to them.

The new role of the teacher will be to work individually with all students on whatever problems and questions they may have in assessing and handling the new concepts. Tutorial systems allow teachers greater opportunity for personal interaction with students.

How will computer-assisted instruction affect teacher-administrator relationships? Teachers and administrators should be able to develop even closer relations in a setting where computers are used to aid instruction. The information-gathering capacity of the computer enables administrators to have a much more detailed profile and up-to-date picture of the strengths and weaknesses of each area of curriculum. As they develop skill in interpreting and using the vast amount of information about students provided by the computer, administrators and teachers should be able to work together more effectively for improvements in curriculum.

Is there a danger that the computer will impose a rigid and impersonal regime on the classroom and even replace teachers? Contrary to popular opinion, the computer's most important potential is to make learning and teaching *more* an individual affair rather than *less* so. Students will be less subject to regimentation and moving in lockstep because computer programs will offer highly individualized instruction. In our own work at Stanford, for example, we estimate that the brightest student and the slowest student going through our tutorial program in fourth-grade mathematics have an overlap of not more than 25 percent in actual curriculum.

The computer program is neither personal nor impersonal. The affect and feeling of the program will depend on the skill and perceptivity of those responsible for constructing it.

There seems to be little reason to think that computers will ever replace teachers or reduce the number of teachers needed. The thrust of computer-assisted instruction is to raise the quality of education in this country, not to reduce its cost. In any sort of computer-assisted instructional system used in classrooms in the near future, teachers will continue dealing with children on an individual basis and doing most of the things they are now doing during most of the school day with only slight changes.

Finally, we emphasize once again that no one expects that students will spend most of their school hours at consoles hooked up to computers. They will work at consoles no more than 20 to 30 percent of the time. All teachers everywhere recognize the help that books give them in teaching students. The day is coming when computers will receive the same recognition. Teachers will look on computers as a new and powerful tool for helping them to teach their students more effectively.