Potentialities, Problems, and Prospects

Computer-Based Instruction

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IN the fourteenth century, the process of education was almost entirely oral. On most days, the teacher would read selected portions of a text from a manuscript, and the students were expected essentially to memorize what the teacher said. On the following day, the work would begin with a recitation of what had been covered the previous day. There were no printed books, of course, and even the manuscripts used by the teachers were rare.

Today, printed matter dominates a large part of personal and mass communication and is central to regular school instruction.

Is there a parallel between the introduction of books and the coming introduction of computers as instructional devices? There is every reason to think that a comparable revolution has already begun; even the most conservative forecast for the next century must assign a prominent place to computer-based terminals in classrooms.

It is of the greatest importance, however, to emphasize that the existence of the technology and the recognition of its possibilities do not guarantee that it will be used or that it will be used with maximum efficiency. In many respects, the deep and complicated problems only begin when the technology is ready for application and decisions must be made as to how it should be used.

Four major aspects of computer-based instruction seem to offer great potentiality for education at all levels, particularly at the elementary-school level. The first and most important is concerned with the well-known psychological generalization that there exist definite and clearly significant individual differences. For obvious economic reasons, schools are not able to offer a curriculum program to each child according to his individual needs. In the elementary school, the teacher is running a three-ring circus. She cannot give very much attention and accommodation to individual student differences in the many different subjects she teaches, no matter how willing or able she may be.

The best single reason for using computers for instruction is that

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computer technology provides the only serious hope for accommodation of individual differences in subject-matter learning.

Among other areas in which computer-assisted instruction has valuable potentialities is the important matter of correcting responses, keeping records, and relieving the teacher of routine, so that she may teach her class as she would like to do. A group of first-grade teachers were asked, "How long would you need to spend on your students' workbooks in mathematics outside the class if you did an adequate job of marking?" "About an hour and a half a day," was the average response. In a computer-assisted environment, this correction can be done automatically, and the teacher is relieved of an enormous chore.

Closely related is the matter of a systematic and straightforward introduction of many of the standard skills. As we study in detail how the children are learning and performing, computer routines can be developed that the teacher can use to introduce most of the children to many standard algorithms. The routine introduction of standard skills can be handled by computer-based terminals. The teacher can then move to the much more challenging and important task of trouble-shooting, since it is inevitable that, in these early years, the depth of programing and the depth of the alternatives we can offer will be insufficient to cover all children.

The fourth potentiality of computer-based instruction is that, for the first time, educators will have the opportunity to gather data in adequate quantities, and under sufficiently uniform conditions, to take a serious look at subject-matter learning. Enormous gaps exist, for example, in the literature of elementary mathematics learning; as for real analysis of how students learn this subject, we as yet know very little.

PROBLEMS

A number of pressing problems confront attempts to implement computer-assisted instruction. The first problem is that of reliability. The machines have to work right; the program has to be thoroughly debugged. Chaos is introduced if over a sustained period children are put in the terminal environment and the program and machines do not perform as they should.

The second problem is the tendency to neglect curriculum content because of concern with the surface programing problems. It is far too easy to make the curriculum too simple or to forget important aspects of interest and complexity.

The third problem is this: In computer-assisted instruction, can the student be provided with a rich-enough stimulus environment? There is no doubt that this can be done in the beginning, but the second or third year may bring larger difficulties in this respect. Certainly mistakes will be made, and children may become bored. On the other hand, the problem is not psychologically as complex as many

people would like to make it. There is no doubt that, other things being equal, the children have an enormous initial interest in using the equipment that is part of computer-assisted instruction. With proper nurture of that interest, the problem of stimulus deprivation and the associated problems of motivation can be overcome.

The fourth problem will become a pressing one with the universal use of computer-assisted instruction. This problem is how to make the cost reasonable for use on a very wide basis in schools throughout the country. For a variety of reasons, however, the economics of computer-assisted instruction will look much more feasible in two or three years.

With respect to the future of computer-assisted instruction, there is no doubt that the skill subjects can be handled most easily and effectively in this environment, though other subject matter will eventually be presented successfully, too. But at the present we can bring the skill subjects under control in a deep and organized way and can present them to the student in a manner that is desirable from the standpoints of both psychology and curriculum. The subjects that would be particularly important are reading, mathematics, and foreign languages. Foreign-language teaching is one of the most promising areas in which to apply computer-assisted instruction.

Another important prospect of computerized education is its ability to upgrade the standards of those aspects of elementary subjects concerned with drill and practice. From a psychological standpoint, we can control in a much more substantial way the kind of variables that learning theorists have talked about for decades. It is difficult to emphasize enough the impact that widespread use of computer-assisted instruction can have on the mastery of skills.

The general conception of drill-and-practice work is not, of course, one that originates with the advent of computer-based instruction. It is rather that a concept that has been present for some time can receive the appropriate and proper kind of application. Computer-based approaches to instruction open the possibility of bringing to drill-and-practice portions of instruction a level of standard and analysis that simply has not been feasible previously.

A question often raised is: Are we trying to eliminate the teachers? No move in the history of education in this country has led to a reduction of teachers, and I think exactly the same thing is true of computer-based instruction. The cost of instruction and the number of teachers will not be reduced; rather, the quality of education will be raised. Nearly all teachers regard textbooks as an indispensible aid to good teaching. It seems to me a reasonable prediction that the same will be true of computer-based teaching terminals in the not very distant future.