ALFRED BORK

Let's Test The Power Of Interactive Technology

We should check out the possibility that computer-based curriculum can significantly improve American education by developing a trial set of courses.

The time has come to seriously evaluate the idea that interactive technology can significantly improve American education. Our nation's school system is dangerously weak, and few of the prescriptions offered for strengthening it are likely to be filled. We have enough evidence for the effectiveness of interactive technology to warrant a trial project, which, if successful, should lead to a major development effort.

Our Educational System Has Serious Problems

The evidence for deficiencies in our educational system is so well known that I will not recite most of it here. I will refer only to problems of financing, to concerns about the quality of learning, and to circumstances of teachers.

Financing. During much of our history, the general population was happy to support public schools, but now education must fight for funds. Part of the reason is a growing resistance to taxes for any purpose (even though our taxes are low compared with other leading countries). We spend $140 billion each year on our schools. Because our present system is labor intensive, much of this is in salaries. Because of our national reluctance to put more money into education, teacher salaries are low: recent data from the National Education Association put the average salary at $23,000, the lowest average salary in the United States for a position requiring a university degree. To summarize, our schools are not well funded, and the prospects for better funding are poor.

Learning Outcomes. It is not easy to measure quality of learning, but most studies about education in the United States have concluded that the quality is relatively poor and probably declining. From the standpoint of international economic competition, it is disturbing to note that international testing shows our students lag behind those in competing countries. From a different point of view, Gallup polls show that about half the parents in the United States are unhappy with the schools their children attend. Further, many courses are old and do not reflect current knowledge and attitudes.

Teachers. A third factor is the condition of the teaching profession. As already noted, teacher salaries are low. The working conditions for teachers are also poor compared with many other occupations. Hence it is not surprising that fewer able university students are now considering teaching as a career. Schools of education have had drastic declines in the number of students preparing for teaching and in the quality of students entering their programs. We train, for example, about one fifth of the number of mathematics teachers now that we did ten years ago!

Over half of the schools in the United States, mostly those in rural areas, no longer teach advanced science and mathematics courses, because they no longer have qualified teachers in these areas. The National Science Teachers Association estimates that 30 percent of the existing science teachers are highly inadequate. Many of our existing teachers will retire in the next decade, and we have at present little prospect of replacing them with excellent new teachers.

Most of the solutions being suggested for these problems are inadequate. We must find new answers.

A Powerful New Learning Technology Is Available

Not since the printing press has a technology had such far-reaching ramifications for education. The most important advantage of the computer is that it allows learning to be interactive for all students. In earlier eras most learning was interactive, with the student playing an active role in the process. Even today a few can afford private tutors or other highly interactive approaches. But with the need for more and more people to be educated—both because of population increases and because education has come to be considered a human right—we have moved to less interactive learning approaches: the lecture and the textbook.

At least two types of interaction characterize good computer learning situations: interaction between students and the computer, and interaction among students themselves. Consider two or three students working together, using a highly interactive computer program. The learning sequence proceeds Socratic fashion as the computer asks questions, perhaps every 15 or 20 seconds. The questions are in ordinary everyday language, and the answers are free form, with students typing in anything they wish. Student answers receive reasonable replies, and lead to new questions. (We already have working examples of such Socratic dialogues available on computers.) One type of interaction, then, is between the student and the computer.

But the computer also stimulates another type of interaction: discussion among the students as they work together at the computer. There is more peer interaction in this kind of setting than there is in most current classrooms—and it is focused on the learning process. Students help each other to understand the material, a powerful learning aid.

One very important aspect of interactive technology is that the learning activity can be specifically suited to each individual. Because the student is frequently responding, the computer can build up information about the

strengths and weaknesses of that particular student. This allows learning to be individualized, so that every student can receive an individually tailored learning sequence. Another aspect of the computer's flexibility is that students can take as much or as little time as necessary at each step in the learning process. Because they receive only the help they need, most students learn more efficiently.

Unfortunately, most computer-based materials do not make appropriate use of even existing capabilities, let alone those currently being developed. Much of the available software is primitive. Because educators have not seen materials with the characteristics I have described, they tend to judge the computer on the basis of the limited modules they have seen. For this reason and others, many people are not convinced that computer-based learning modules could be the basis for a new educational system. Education has continued so long in its present mold that many think of the present system as eternal.

What is more, even computer enthusiasts will freely admit that a fully developed computer-based educational system is far, far away from our current limited use of computers. We need to scale up by many orders of magnitude to make a major difference, and doing so is risky because we have little experience in developing and using such materials.

An Empirical Approach

The potential value of such an effort need not be debated on a philosophical level, however; we can use an empirical approach. I propose a six-year trial project, the first years of which would be devoted primarily to development of curriculum materials, with a gradual shift to implementation and evaluation.

In the trial project, about 20 full-scale courses should be developed covering the educational spectrum in age and subject areas. To encourage a wide variety of approaches, different agencies would be involved, with no agency developing more than two courses. We should not expect all the new courses to be successful, but I believe we would find that some would be highly competitive with conventional instruction.

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If the experiment is successful, we should then proceed to develop new technology-based courses in all subject areas. In the process we would expect to learn more about how to design such computer-based curriculum, but should continue to insist upon a diversity of approaches; there should never be a single official philosophy governing course development or structure.

Another type of diversity is also important. Our educational system, unlike those of some other countries, is not planned at the national level. In principle at least, local schools can make independent choices (although in practice these choices are often affected by the limited availability of learning materials). Because we cherish this diversity, it will not be sufficient to have only a single course in a given area. For example, there should be not one but several beginning high school algebra courses. All courses should be designed to be as flexible as possible, so that a skilled teacher would be able to adapt the materials to the local situation and perhaps even combine components from several sources.

A critical issue in this connection is the effect on teachers. Technology gives us the possibility of an educational system requiring fewer teachers, but this should not be perceived as a threat to the teaching profession, because it also makes possible new and more interesting roles for well-qualified teachers.

The proposed full-scale development would be an extensive activity, but not unrealistic compared to other projects we have undertaken as a country, such as putting a man on the moon. It is not unlike some large-scale efforts in science, such as the building of huge accelerators, or similar efforts in industry. Our nation has considerable expertise in the management of such projects. The full developmental activity would occupy a period of about eight years. I estimate the cost to be about one billion dollars a year, or about ten billion dollars altogether.

Accompanying the development would be evaluation, both formative and summative. After the major development period there would be continuing development of new courses, but at a reduced scale. Summative evaluations, advances in knowledge, and new approaches to learning would be factors to consider in deciding where continuing development was necessary.

Developing the new curriculum would, of course, be only part of the process. At least as difficult would be installing the system in schools, including teacher training. Those responsible would need to be fully aware of the research on school cultures and on processes for bringing about extensive changes in large social systems.

We Should Try

I have suggested in this brief paper a process that could lead to far better learning for many students. Details are missing; leadership would be needed to carry it out; but such a process could give us, once again, the best educational system in the world. The technology exists, and the cost, compared to other national efforts, is reasonable. We need not argue about how successful such an effort would be; we should try it, in a carefully controlled experiment, and find out.□

Alfred Bork is professor of education and computer science, professor of physics, and director, Educational Technology Center, University of California–Irvine, CA 92717.