The micro-boom is on. Computers are a common sight in schools, and computer literacy is becoming a standard part of the curriculum. Teacher inservice courses on microcomputer use proliferate in the most prestigious university schools of education, in the not-so-prestigious college weekend extension programs, and in the blatantly commercial storefronts and offices of hardware manufacturers and sellers. While these courses range widely in both their style and substance, “Don’t be left behind” appears to be their most salient message. As the world is being revolutionized by computers, the future of schools and teachers, it seems, will be digital as well.

**Teachers: The Similarity Between Humans and Computers**

Can computerized education come to resemble or even replace human-to-human teaching and learning? “Not to worry,” teachers are constantly assured, “computers are not the smart machines we give them credit for being; they only know what humans teach them.” Computers, it is said, will never provide the multiplicity of modes and responses that sensitive human teachers have at their fingertips. They will never be able to respond appropriately to the divergence in students’ creative output, to weigh differences of opinion, to interpret questions of values, or to ferret out a complicated thought process. Computers will never communicate the joy of discovery and the pleasure in helping someone learn. Teachers will always be required for those subtle and complex interactions that are the heart of the teaching/learning process.

But are these human interactions, in fact, at the center of teaching and learning in classrooms? Those of us

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**JEANNIE OAKES AND MARK SCHNEIDER**

**Computers and Schools: Another Case of “... The More They Stay The Same”?**

To keep computers in classrooms and out of closets, schools need to take a culturally responsive view of these new tools—by promoting “ownership” among the teachers who are to use them.

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who analyzed data from A Study of Schooling found something quite different from this ideal picture of classroom instruction (Goodlad, 1983). Teachers who employed a wide variety of learning modes were extremely rare. Teaching was almost exclusively the presentation of information, and learning was nearly always seen as the passive intake of information or as practice. Within these two classroom configurations, teachers out-talked their students by a ratio of nearly three to one. And most of this teacher talk consisted of telling—the presentation of information. During the small amount of questioning that took place, fewer than one-sixth of the questions were open-ended, requiring students to respond in complex ways. Chances of learning modes were extremely rare. Teaching was almost exclusively passive intake of information or as practice. Within these two classroom configurations, teachers out-talked their students by a ratio of nearly three to one. And most of this teacher talk consisted of telling—the presentation of information. During the small amount of questioning that took place, fewer than one-sixth of the questions were open-ended, requiring students to respond in complex ways. Chances were less than 8 percent that students would be involved in discussion, simulation, role playing, or demonstration. Students worked cooperatively only 10 percent of the time.

Further, these classrooms had an emotional climate best described as flat—little warmth and enthusiasm, encouragement, or praise was expressed by teachers. Nor was there evidence of much eagerness, curiosity, or overtly positive responses by students. Happily, overtly negative behavior was noticeably absent as well. The evidence, therefore, casts doubt on the central role of the subtle interactions we say we value in teaching and presume computers cannot duplicate. Such uniquely human qualities may be more instructional myth than reality.

Computers, on the other hand, allow students of varying abilities to cover varied materials at varying rates. The word here is very. Does this variety benefit the student by accommodating different learning styles and encouraging more active modes of learning, or does it benefit the teacher by allowing greater ease in following traditional modes of teaching? A look at the most common types of computer-based materials will help answer this question.

Drill and practice. Drill and practice is the predominant mode of computerized instruction in use today. Any objective knowledge that can be memorized, spit back, and easily judged for correctness is prime material for such a program. The key seems to be the ease with which an answer can be right or wrong.

Recently, classroom tested drill-and-practice courseware has been enhanced with the addition of limited authoring capabilities that allow teachers to tailor materials to a particular course by typing in their own lists of questions and answers. This option makes the program a bit closer to what teachers have been doing already—some revolution!

Do students learn more or better with the questions on a screen instead of in a workbook? Instruction may be more individualized because students can study different lists, but is a computer really necessary to accomplish this task? It definitely is easier for the teacher, as the recordkeeping capabilities of many courseware packages free the teacher from such chores. But does this alter the educational process, or is it just more of the same in a new package?

Tutorials. If drill and practice are linked to electronic workbooks, tutorials may be compared to electronic textbooks. A typical program leads a student through the material being presented, the only variable being individual reading rate. This approach may be worthwhile if the material is graphically presented on the screen in a way superior to chalkboard, film, video, books, and the like. More elaborate tutorials allow students to repeat sections they are not sure of, but few programs help students decide when repetition is desirable. The only variables are those that relate to how quickly students understand the material. Everyone goes through the same material in the same way.

Who benefits from tutorials? Certainly not students whose reading level may be below the comprehension level for the material being presented. Furthermore, students will probably not learn more than they could from a live presentation that might encourage more active learning modes. On the other hand, teachers do not need to prepare each demonstration or worry about repeating the demonstration for absent students. Even slower students are provided for. If they don't understand the first time, the patient computer will let them view it again.

Tutorials, like drill and practice, seem to make it easier for teachers to retain status quo teaching strategies. The primary modes of teaching have not really changed—only the labels applied to them. Teacher lecture has given way to a slicker computer lecture, and workbook drill has been replaced by electronic drill.

The Potential of Computers for School Improvement

If this is the case, what hope can we have for significant educational improvement via the technological revolution? Surprisingly, quite a lot. Two factors in the computers-in-education movement have potential for promoting fundamental school change: (1) computers have entered the schools in a big way, both in the actual number of people and schools affected and in the tremendous interest in the technology itself; and (2) the computer's potential for making possible new modes of effective instruction and learning is great. But unless schools bring about fundamental changes in the way they do their work, this potential has little hope of realization. Let us look more closely at why these two factors are conducive to school improvement.
First, the widespread adoption of computers indicates a prevailing view that the computer represents both substantial challenge and considerable promise. Why does this make change likely? Certainly, conventional wisdom leads us to assume that larger changes are more difficult and more easily resisted than smaller ones. However, there is evidence to the contrary.

For example, the Rand Corporation study of factors affecting the implementation of federal programs supporting educational changes in the 70s found that the amount and complexity of change required of teachers in their classroom procedures was positively related to the occurrence of change (Berman and McLaughlin, 1977). The dimensions of these large-scale projects that resulted in more overall change included changed classroom organization, curricular revision, and considerable extra effort required by teachers.

Clearly, the infusion of computers into instruction in existing school subjects involves all three dimensions. The physical presence of the hardware itself requires some organizational re-arrangement, the curriculum is certainly revised, if only in mode of presentation; and becoming not only computer literate but a computer teacher requires considerable effort beyond teachers’ usual daily work. What can happen, given the right context, is that as these adjustments are made, profound changes can occur. Once we are in the midst of physical and organizational rearrangements, other areas of the curriculum come under scrutiny.

We know that a classroom’s physical arrangement has substantial influence on its social organization. So, while we are moving the furniture, we might reflect on what types of configurations support the kinds of human interactions that are most conducive to academic learning and to the social and personal development of students. For example, the power of cooperative learning might be explored with small groups of students working with a single terminal. Further, as we alter the mode of instruction from textbook/workbook to software, we might consider whether the content we now teach is what we really want students to encounter. We might even question whether we want to continue to view learning as the relatively passive acquisition of knowledge created by others. The big deal surrounding computers in schools, then, gives hope for significant change.

Second, the technological capabilities of computer hardware and software bring new teaching and learning modes within reach. New programs—simulations—encourage the use of higher level learning skills instead of just testing recall. As the name implies, they try either to simulate realistic problem-solving situations or to encourage the manipulation of objects in a highly controlled, self-contained mini-world. These programs offer students classroom experiences that were not available before computers, such as a graphic journey through the human body. The learning potential of these new modes is both exciting and challenging to educators (see for example, Dwyer, 1980).

One of the most common forms of simulation is the adventure format, where students take on the role of an explorer or fictional character and plan strategies to solve problems thrust upon the character. What a wonderful opportunity for groups of students to interact and cooperate in problem-solving situations. But how are adventures currently being used? If they are used outside of normal classroom hours or as a reward for faster students who finish their normal assignments, then the students lacking in these problem-solving skills are the students least likely to use these programs.

The most well-known of the “mini-world” simulations is the LOGO language, developed at MIT over the last two decades. The potential for LOGO (Papert, 1980) is great, but today it is used almost exclusively by individual students for creating geometric drawings. Little of the rich verbal interaction of which the language is capable is being exploited. Probably because LOGO goes beyond familiar classroom practice, teachers limit its use. Potentially revolutionary, LOGO’s possibilities have yet to be realized in today’s schools.

The complex nested structures of LOGO can be used to significantly enhance traditional (well-known) CAI programs as well. Take a traditional tutorial program, add the ability to evaluate progress and nest subprograms, and you get a sophisticated system that can address individual differences. Such a program can identify a student’s difficulties and branch to subprograms that address areas needing remediation. Programs of this scope generally are available only on large mainframe or minicomputers, as the memory needed to store all of the subprograms is greater than currently available on individual microcomputers. Yet, clusters of micros can be networked to a hard disk drive, with access to hundreds of times more memory than is contained within the single computer. Once hard disk drives make their way into schools, the technological barrier to rich, multi-level courseware will have been overcome.

“If education with computers could approximate current human-to-human teaching... then not much would be gained or lost because truly significant, lasting changes rarely take place in schools.”

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Other technological innovations for use with the microcomputer include speech capabilities and light pen devices that allow simple and quick interactions by just touching the screen with the pen. In addition, video disk interfacing holds tremendous promise for classroom utilization; and as the component prices become lower and access speeds increase, we can expect to see more multi-modal instruction, which will address many more learning variables than can now be addressed.

The Potential for Failure

But, of course, just because an innovation is perceived as large in scope with the capacity for significant change, change does not automatically occur. We have a long history of innovations that resulted in very little alteration of either the content or the mode of schooling.

What causes educational innovations to fail? Certainly not a lack of good ideas, nor an absence of enthusiasm about them. What has been missing is an appropriate perspective on how change happens in schools and the specific implementation strategies that flow from it.

For the last 20 years school innovations have been introduced almost exclusively by the research, development, and diffusion mode (RD&D), which usually begins with the development of a sound educational innovation that meets the needs of the school. However, it is the policymakers who study it, determine its effectiveness, and mandate its implementation. What of the people, primarily teachers and students, who are the objects of the proposed change? The innovation loses its power because it gets disseminated by experts, who want teachers to understand or at least

"Because learning activities are developed from a computer-free perspective, the project is driven by curricular ideas rather than by the limitations of computer technology."
adopt the changes with little, if any, input. When it is solicited, input is usually gathered after the genuinely important issues have been settled.

Thus, schools are passive targets for particular innovations. A single aspect of the school or classroom comes under close scrutiny, and the innovation is applied to isolated elements rather than integrated into the whole of schooling. When attention to the innovation subsides, as it usually does before long, attention to that part of schooling diminishes also. The RD&D perspective does not admit the realities of how schools resist or effect change (Goodlad, 1975; Sarason, 1982). The focus is on getting teachers to change rather than on changing the conduct of schooling itself.

The Culturally Responsive Perspective

An alternative approach to change proceeds from a culturally responsive perspective (Goodlad, 1975). The differences between this view and RD&D are several and important. First, in the culturally responsive view the purpose of change activities is to create a self-renewing school: staff members work together to examine the conditions of the school, identify problems, and develop alternatives based on their own experiences and on research in the field. The self-renewing school may use ideas from the outside, but the intention is not to make the school a target for innovations developed outside the school.

Second, the primary focus is on the dispositions of teachers and others in the school toward the processes and concepts of change rather than on changing specific structures or teacher behaviors. Having the school staff critically examine their assumptions about how schooling can and should best proceed, together with information about what actually happens, is necessary for solving problems. But since schools are vulnerable to social and political pressures from both inside and out, the culturally responsive perspective recognizes the support and encouragement schools need if they are to attempt anything beyond day-to-day survival (Heckman and others, 1983).

How, then, does this culturally responsive view translate into ways schools can successfully integrate computer courseware into their curricula? First, those at the school must be central in designing or adapting the substance of the courseware itself, making it appropriate to the needs of the school and its students. In this way, not only is an appropriate innovation developed, but it is one owned by those who will use it. Second, these efforts must be supported at the school with time and resources for the development activity and with a sense of the project’s importance. In addition, support in the form of ideas or resources from outside the school can help raise the substance and the process of the innovation beyond conventional wisdom and common sense assumptions that develop when a school staff is isolated from theory and research.

What are some of the practical considerations that arise when teachers examine the curriculum in light of the current research and their own experience? If the teachers are lucky, the determination of those areas most in need of change will include some that may be seen as “easy”: the internal programs and processes controlled at the school level such as bell schedules, room environments, and student tracking traditions. If staff members, teachers, administrators, and parents work together, such logistical features can be altered as part of an overall implementation strategy.

But the more substantive type of change is critical and probably more difficult to accomplish. Curriculum change usually collides with rather rigid counter-expectations at many levels of the educational and social community. Communication among and within all components is critical. School administrators must first create a forum for teachers to meet and grow. Teachers must be encouraged to question current practices without fear of being labeled troublemakers. Time must be provided for curricular questions to be addressed, and educators involved in theory and research must participate not as change merchants but as facilitators and experienced partners in change.

The school district must, in addition to scheduling release time for teachers to develop curriculum, ascribe a sense of importance to this task and encourage the use of new ideas in the classroom. And in universities, schools of education and liberal arts must work together. Traditional divisions must be bridged through communication so that one does not encourage curricular change while the other resists it.

But, even with all elements in place, will teachers create intelligent, exciting, and sound computerized educational programs? Although many teachers claim that they have written such materials, very few programs can function both as integral parts of the curriculum and as thought-provoking, active learning tools. Teachers generally do not have the programming skill
"We hope to create a self-renewing environment in our project schools that will make future change a much easier and nonthreatening task."

needed to make exciting programs, while programmers, although well-versed at graphics, animation, and sound techniques, usually do not have the background and experience to develop programs that are both educationally sound and uniquely fitted to diverse classrooms. Traditional authoring programs may include some benefits of both professional programmers and educators, but nothing exciting or important has yet been produced by such structured programs.

**Confronting the Problems and Possibilities**

Earlier we asked how computerized education could resemble or replace human-to-human teaching and learning. An interim conclusion we can draw is that even if education with computers can approximate current human-to-human teaching, not much of significance will be gained or lost. Given that truly significant, lasting changes rarely take place in schools, we now offer a new question: how can we use the spirit of innovation surrounding computers as a vital component of meaningful school improvement and keep computers themselves out of the closet where the learning kits, teaching machines, video equipment, and other flotsam of failed innovations are stored?

A project now under way at UCLA's Laboratory in School and Community Education is confronting the problems and possibilities of school change with computerized education. Using the culturally responsive view of school change as a model, the project's central purpose is to investigate whether a collaboration of public school teachers and university-based researchers can result in the conceptualization, development, and implementation of exemplary computer curricula in basic subjects at local school sites.

The work of the collaborative team did not begin with the development of courseware, however. An intensive examination of current curricular beliefs and practices, a survey of research and theory in language arts and mathematics education, and the conceptualization of what curriculum would be ideal for students preceded any computer work.

During this initial phase, steps were taken to ensure necessary support for project schools. Both district and site level administrators helped conceptualize the project itself and made a substantial commitment to its importance to their schools. In addition, material resources and equipment were designated for project use. The school principals arranged working space at each school and facilitated release days for meetings. These internal supports helped teachers view their involvement as meaningful and their results as important.

Furthermore, the Laboratory at UCLA provided additional support and resources. Five weeks of intensive planning, reading, thinking, and discussion for the entire team were scheduled at the Laboratory before the project year began. The teachers were considered part of the Laboratory staff as well as members of their school faculties. Summer salaries and part of their teaching salaries were paid from project funds. Even more important, the involvement of the university has begun to provide the necessary support for teachers who have tried to confront educational problems in new ways. The researchers, too, have encouraged ideas that go far beyond conventional wisdom about teaching and learning in language arts and mathematics and about the use of computers in schools.

During the development phase, the work of the project took place at both the university and the school sites. The teachers' first activity was to translate the "ideal" curricula—conceptualized during the summer—into learning experiences that could be tried out in their classrooms. Following these trials, the series of lessons were examined as to how computers might enhance them and, of course, student learning. Throughout the project we have been careful to address curricular issues first and then try to adapt computer technology to them.

"It is disconcerting to think that 95 percent of teaching and learning takes place in an environment so neutral that it is hard to believe anyone cares very much about what is going on."
An experimental authoring system that allows considerable curricular flexibility while providing the best of microcomputer technology—color graphics, animation, and sound—is being used by the teachers to adapt their curricula to computer courseware. The sophisticated system leads students through the curriculum in a manner that allows for their varied learning styles and backgrounds. Branching and nesting of programs enable all students to experience a common curriculum without the holding-back or hopelessly-lost syndromes teachers encounter in heterogeneous classrooms. Exciting lessons and graphics are relatively easy to create without the need for professional programmers.

By addressing the process of change in a way that encourages teachers to own this innovation and provides them considerable support, the project allows teachers to explore areas of the curriculum that have long resisted change attempts. Through this process of change, aided by the awesome potential of the computer, we hope to create a self-renewing environment in our project schools that will make future change a much easier and non-threatening task.

References


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