

**DEVELOPMENTS IN THE USE OF MICROCOMPUTERS  
IN NORTH AMERICAN SCHOOLS:  
TO WHAT EXTENT IS THE TEACHER'S ROLE CHANGING?**

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**Are Computers Making an Impact on Teaching and Learning?**

Many North American educators have stated that the computer is making a profound impact on the role of the teacher. It has been predicted that 'within twenty years the computer will be the major delivery system for education at all levels and in practically all subject areas' (Bork, 1984). Teachers are told that computers are causing a 'revolution' in schools and that, because of computers, teachers 'must evolve or dissolve' (Kelley, 1985), and, 'as the world is being revolutionized by computers, the future of schools and teachers, it seems, will be digital as well' (Oakes and Schneider, 1984).

In some ways the view that computers are causing a revolution for North American teachers appears to be supported. Whereas in 1979 even a single microcomputer was a novelty in most North American elementary schools, today multiple microcomputer systems are commonplace in educational settings. Between Spring 1983 and Spring 1985 the number of microcomputers in use in U.S. schools quadrupled, from about 250,000 to over one million; the median number of computers in elementary schools rose from 2 to 6, and in secondary schools rose from 5 to 21 (Becker, 1986). In addition, approximately 85% of U.S. secondary schools and 30% of U.S. elementary schools now have a computer laboratory (Becker, 1986).

In Canada, computer activity is comparably well established (Simair, 1985). For example, the province of Ontario supports the ambitious integration of hardware support, software development, and teacher training through its Computers in Education Project which, among other activities, subsidizes Ontario schools in their acquisitions of networked microsystems and locally developed software (Penny, 1986). Other Canadian provinces also support innovative developments in the application of computers in education, notably Manitoba with its software development and distribution project (Sandals, 1986), and Alberta with its activity in both local-area and wide-area networking (Bell, 1986).

Teacher training opportunities relative to computer use in education have also proliferated. For example, a survey of Canadian teacher training institutions (Collis and Muir, 1986) found all but one of them to offer credit courses in some aspect of computer use for teachers. In addition, less formal computer-related training is now readily accessible to the majority of teachers. 'Computers in education' conferences appear throughout North America, with virtually every state and province hosting annual computer-using teachers' meetings or conferences.

And yet, despite all this activity, there is little evidence of many, or even any, substantial overall changes having occurred in the essential aspects of education; in what students learn, or how they learn, or in how teachers teach (Oakes and Schneider, 1984; Tucker, 1985). The average North American elementary school microcomputer is likely to stand idle 75% of the time (Becker, 1983); only 15% of secondary school teachers, including those teaching computer science, use computers with any regularity (Becker, 1986); the typical science teacher has never once used a computer as part of the science laboratory or lesson (Lehman, 1985); only about 6% of

secondary school English teachers have used a computer in connection with their teaching (Newsnotes, 1985); and the majority of secondary school students have no contact at all with the school microcomputers (Beckers, 1986). In general, despite their 'potential' and their presence in schools, 'computers have not found a place in the curriculum' (Schubert, 1984). The educational community is beginning to be told that 'the computer revolution in schools has failed' (Tucker, 1985), that teachers should develop 'techno-skepticism' (Reinecke, 1984), and that 'the infusion of computers into schools seems to be yet another case of the more things change, the more they stay the same' (Oakes and Schneider 1984).

Why is this? And what impact, realistically, can we expect microcomputers to have on the teacher and on the overall educational experience?

### **Why are Computers Having Little Real Impact on Learning and Curriculum?**

It was convenient during the early 1980s to blame lack of hardware and software and lack of teacher training for the average teacher's non-utilization of microcomputers as classroom instructional tools or agents (Luehrmann, 1980). Software is still difficult to obtain, but many school units have acquired software that now lies unused, in area resource centres. Although it is still true that many good ideas for computer usage require more hardware than may be available, there are many excellent educational applications of computer that can be done with a single classroom computer, but which are infrequently employed. Certainly teachers continue to need guidance and support, but many existing resource materials are unknown to or unused by many, if not the majority of, teachers. Two fundamental reasons may account for this underutilization of existing computer resources in North American schools: first, the difficulty in expecting any innovation to alter the established teaching and learning procedures present in schools (Heckman, Oakes, and Sirotnik, 1983); and second, an inappropriate view of educational computer usage.

#### *Teaching Styles Resistant to Change*

John Goodlad (1983), a U.S. educator, has recently completed a study of the teaching and learning process in over 1,000 classrooms. Goodlad observed that teachers across grades and subject areas relied on two dominant instructional strategies: (1) lecturing or demonstrating in the whole-class setting, and (2) directing students to work alone, using textbooks or worksheets.

This teaching-learning configuration has been common in North American classrooms for many years (Hoetker and Ahlbrand, 1969; Stevens, 1912) and remains highly resistant to change, despite waves of enthusiasm for different approaches to classroom organization and instruction (Sarason, 1982). This resistance to change is reinforced by the fact that in North America teachers must follow set curricula, respond to standardized examinations, teach batches of students for pre-set blocks of time, and handle layers of tasks and situations, ranging from administrative record-keeping to mainstreaming exceptional students. Teachers are busy, sometimes overwhelmingly busy, as they handle these many roles and manage the flow of the school day. Teachers may also, sometimes, become overly confident about the effectiveness of their familiar classroom routines.

The many demands on time and the strength of routine may make it difficult for

many teachers to leave the model of teaching which they know best and which they also know is reasonably efficient and effective. This model involves lecture and questioning, interspersed with classwork and testing and reinforced by textbook problem-solving, readings, and paper-and-pencil homework assignments. The use and management of classroom computer does not fit comfortably into this model. The model does work – teachers are the products of it – and it has been little affected by the long-standing presence of educational technologies in schools. Educational television or films or language laboratories or other audio-visual experiences are used occasionally in schools, and by some teachers used very effectively, but in general these ‘older’ technologies have not changed the nature of classwork or learning or of evaluation for most students and most teachers. Although it is possible that the computer may exert enough influence to significantly alter teaching styles where other innovations have not, there is little evidence in North America to suggest that this pedagogic change has begun.

### *Inappropriate View of Computer Use*

An inappropriate view of educational computer usage is not only one which is unrealistic about what computers can or cannot do, but also is one which fails to have its origin in the real, ongoing educational needs that the teacher knows are present in his or her classroom. Very few applications of computers begin with the statement of a real classroom need – some problem or concept that is not well understood by students working within traditional methodologies.

Teachers are intelligent problem-solvers. If they perceive a need exists, they will respond to it. All too often however, the computer is perceived as ‘a solution in search of a problem’ (Railsback, 1983). Teachers do not have the time or inclination to concern themselves with defining a need for computers; their concerns, quite appropriately, grow out of the nature of those needs that are not being effectively met by existing school activities. Because funds have been made available for computers even when other school-related purchases may be less well-funded, schools continue to acquire more hardware and software, or even impressively networked systems. However, it is likely that most teachers will be little affected in their day-to-day lessons, their objective-setting, and how they determine what goes into a student’s marks and grades, unless computer-related proposals are based on instructional needs defined by teachers as critical and relevant.

In addition, once these real educational needs are articulated – and there are many of them – another consideration comes to bear. This involves an identification of tasks that a computer can do well, along with a recognition of tasks at which a computer is probably less suitable than a teacher or a book or a set of concrete, manipulative materials. In general, computers do not reproduce printed materials as well as books, or visual material as well as videotapes/films/printed visuals, or questions and responses as well as teachers. However, there are important contributions that a microcomputer, with its particular capabilities, can make that reflect both educational needs and the patterns of organization and instructional delivery teachers are most likely to prefer. It is in these contributions that the most substantial impact of computers on the teacher may develop.

### **Applications of Computers to Existing Educational Needs**

The following are significant curriculum-related educational needs accompanied by examples of computer applications that can be used to respond effectively to those needs and that could, eventually, be incorporated into the pattern of classroom organization which the teacher is likely to prefer.

1. Students do not write as well or as much as they should. Their written communication skills should be improved, both in mechanics and in organization. A computer can facilitate the writing process. Through the use of word processing, revision and editing can become routine aspects of writing, rather than somewhat punitive chores. Social writing can become commonplace. The use of electronic messages can bring an additional dimension to writing and communicating.

2. Students are weak in organizational skills, in the ability to synthesize information and to formulate good questions that can be addressed by available information. A computer used with a database management programme can support the collection, organization, and retrieval of information in ways not available otherwise. Learning how to look for information and how to ask effective questions will become increasingly important in our so-called 'information society'. Computer practice and use of databases are powerful ways to develop the organization and classification skills already stressed in science and social studies curricula, as well as to develop inquiry skills appropriate for the workforce and social environment into which students will move.

3. Students need to know how to match the types of information they need with sources of information and how to access this information when it is electronically stored. A computer with a modem and subscription to an information network, such as a news service database, should be routinely available to students once they (and their teachers) are familiar with database inquiry. Living in a society characterized by an explosion of information means little if students lack the means to access this information and must rely primarily on teacher-talks and textbook presentation. Regular class use of a modem during current events or 'issues' discussions in social studies and science classes can allow the teacher and class to explore what is being said about a topic or issue throughout the world. This ability is already available – thousands of individuals subscribe to on-line news services or magazine-summary data bases in North America and access them with their home computers – yet its use is still virtually nonexistent in schools.

4. Students need better skills at drafting, interpreting and criticizing graphic summaries of information. Developing the ability to interpret graphic material and to synthesize and organize material for graphic display is an important educational goal, not only because graphing is (or should be) an important part of the science, mathematics, and social studies curricula throughout all the grades, but because facility in graphic analysis is an important, ongoing 'life skill' for all citizens. Information is routinely presented in graphic form – every news magazine and newspaper contains graphs both as conveyors of information and as shapers of opinion. Computers generate graphs quickly, effortlessly and attractively. They can capture data in the science laboratory or retrieve data from social studies data bases or from mathematics class spreadsheet applications, and 'show' the data so that its trends can become the immediate focus of discussion.

5. Students tend to be consistently weak in problem solving, both at finding solutions and, more fundamentally, at selecting appropriate strategies for the investigation of problems. Using a computer as a tool – by learning now to employ a word

processor or a database or electronic communication a spreadsheet, or by writing a programme – provides rich and stimulating problem-solving experiences. No matter what sort of jobs our students will eventually move into, the ability to act effectively in problem situations will always be of critical importance. Although it has so far proven difficult to show empirically that the use of a computer facilitates the strengthening of problem-solving skill, the strategies involved in effectively using applications software and, for some students, in doing programming, are also those which are considered to be important problem-solving skills. It seems reasonable to expect a transfer to occur.

### **How are North American Teachers Relating Computer Use to These Types of Curriculum-Related Instructional Needs?**

The five clusters of instructional needs given above can all be effectively addressed through the use of ‘applications’ software – utility-type software such as word processing, database management, spreadsheet, communications, and graphing packages. None of these is ‘educational’ in its basic purpose, none is designed to serve as tutors or drill agents in a learning situation. Yet their use corresponds not only with instructional needs but also with a new trend in microcomputer utilization that is now emerging in North American schools. Applications programmes are becoming a major focus for school computer use, replacing emphases common to ‘computer literacy’ experiences in North America in the first half of the 1980s – topics such as history of computers and computer architecture and, most significantly, programming (Barbour, 1984).

Programming in BASIC in particular has become discredited in North American schools, partly because Pascal is now the language of choice in secondary school computer science, but more because experiences in school programming have failed to demonstrate relevance to curriculum-related needs or to goals such as the development of problem-solving skills (Lockheed and Mandinach, 1986). An emphasis on programming is now perceived as resulting in ‘computers being used too narrowly in schools’ and ‘in ways which are irrelevant for students’ needs’ (Johnstone, 1984).

In place of programming and ‘computer literacy’ topics in North American schools, state and provincial policies in school computer use are showing ‘a substantial shift . . . toward mastery of applications programmes’ (Barbour, 1984), especially the use of applications packages within the context of traditional curricula and teacher-led whole-class instruction. Applications packages are ‘not a competitor for time with traditional subjects, but a partner’ (Tinker, 1984). Teachers are being encouraged to use word processing in language and composition classes, data base programmes in social studies, spreadsheets in mathematics, and graphing software in science, mathematics and social studies (Lockheed and Mandinach, 1986; Valdez, 1986).

### **How Does This Relate to the Overall Impact of Technology on the Teacher?**

In order to implement computers as inquiry and communication tools, educators will need to become proficient in the use of basic applications software themselves. Word processing and database accessing in particular will in future become assumed competencies for both teachers and administrators, and the ability to use a computer

to generate graphs and text material will become as routine as using photocopying equipment.

More substantially, the ability to use computers as inquiry tools will make an emphasis of these skills easier to implement in the classroom. Teachers will be able to provide more extensive opportunities for gathering, organizing, discussing, and evaluating when computers are used for support. It is possible that, when the use of applications software becomes routine, an increased emphasis on higher-order analyzing and synthesizing will come to be expected in the classroom. The teacher will need to adjust accordingly in terms of expectations for student performance.

### **Where will the teacher's role be relatively unaffected?**

However, in terms of the fundamental aspects of the teacher's role and despite the predictions of various futurists, it seems unlikely that computers will cause a real change. The effective teacher will still organize and manage instruction, both in broad scope and on a day-to-day basis. The computer will contribute little to the effective teacher's empathy or insight with regard to his or her own students – the sense of connection and care which characterizes vibrant student-teacher relationships and, perhaps, underscores learning and performance. This quality of interaction will remain a personal synergetic activity. The wisdom the effective teacher acquires with regard to interpreting students' needs and reactions and the flexibility with which he or she responds to those needs or reactions is very unlikely to be affected by school computers. When the overall role of the teacher is considered, the immediate impact of school computers, even with applications software, is likely to remain modest in scope and effect, except for the teachers who evolve into computer-using specialists, unless or until society as a whole changes in ways we do not yet anticipate.

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