DOCUMENT RESUME

ED 257 440 IR 011 672

AUTHOR Collis, Betty; Muir, Walter
TITLE Computers in Education: An Overview. Publication Number One. Software Engineering/Education Cooperative Project.
INSTITUTION Victoria Univ. (British Columbia).
PUB DATE 31 Oct 84
NOTE 19p.; Project also sponsored by IBM Canada, Ltd.
PUB TYPE Information Analyses (070) -- Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Computer Literacy; *Educational Technology; Elementary Secondary Education; Foreign Countries; Information Systems; *Microcomputers; Program Descriptions; Program Development; School Surveys; *Teaching Machines; Teaching Methods
IDENTIFIERS Canada; *University of Victoria BC

ABSTRACT

The first of four major sections in this report presents an overview of the background and evolution of computer applications to learning and teaching. It begins with the early attempts toward "automated teaching" of the 1920s, and the "teaching machines" of B. F. Skinner of the 1940s through the 1960s. It then traces the development of computer assisted instruction (CAI) that began in the 1960s with the PLATO project, through to the emergence of microcomputer-based CAI. The second section describes the entry of microcomputers into the homes and schools of North America. Distinctions are made between learning about computers, learning with computers, using computers as educational tools, and using computers with specific student populations. The results of three surveys of computer use in elementary and secondary schools are cited. Section three notes the response of faculties of education to the challenge of preparing practicing teachers and student teachers in the intricacies of applying computer technology in their classrooms. The final section describes the facilities, courses, and programs that have been developed at the University of Victoria. Included in this section is a brief description of the IBM/University of Victoria Cooperative Project. (Author/THC)

COMPUTERS IN EDUCATION: AN OVERVIEW

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PUBLICATION NUMBER ONE

UNIVERSITY OF VICTORIA
VICTORIA, BRITISH COLUMBIA
CANADA

IBM CANADA LTD.

SOFTWARE ENGINEERING / EDUCATION COOPERATIVE PROJECT

COMPUTERS IN EDUCATION: AN OVERVIEW

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University of Victoria

ABSTRACT

The paper is comprised of four major sections. The first, "A Brief History of Computers in Education", presents the reader with an overview of the background to, and the evolution of, computer applications to learning and teaching. It begins with the early attempts toward "automated teaching" of the 1920's, and the "teaching machines" of B.F.Skinner of the 1940's through the 1960's. It then traces the development of Computer Assisted Instruction (CAI) that began in the early 1960's with the PLATO project, through to the emergence of microcomputer-based CAI.

Section two, "Microcomputers in the Schools" describes the dramatic entry of microcomputers into the homes and schools in North America. In this section, distinctions are made between, "learning about computers", "learning with computers", "using computers as educational tools", and "using computers with specific student populations." In addition, the results of three surveys of computer use in the schools are cited.

The third section notes the "Response of Faculties of Education" to the challenge of preparing practicing teachers and student teachers to the intricacies of applying computer technology in their classrooms.

The final section describes the facilities, courses, and programmes that have been developed at the University of Victoria. Included in this section is a brief description of the IBM/University of Victoria Cooperative Project.

COMPUTERS IN EDUCATION: AN OVERVIEW

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1. A Brief History of Computers in Education

For more than 50 years, educators have been attempting to devise effective methods for individualizing instruction under the assumption that students learn better at their own speed. In the mid 1920's, Sidney Pressey, in the U.S., designed what is generally recognized as the first automated scoring device to aid individualized instruction. His creation, which looked somewhat like a miniature, old-fashioned cash register, allowed the student to respond to a set of multiple-choice questions which was asked after he or she had read the printed passage of material to be learned. By pressing the proper key the student immediately was given confirmation of the correct response as the key was depressed to its full extent. Any key other than the correct one could not be depressed. A record of the student's responses was registered on a card so that the teacher could determine the number of attempts required before the correct answer was achieved.

B.F. Skinner in the 1940's applied his concepts of "operant learning" and "reinforcement" to the development of the "teaching machine." Here, not only were questions asked in an automated manner, but the initial learning materials were also presented by th machine. From Skinner's work emerged what came to be known as "programmed instruction" or PI. A great deal of research and development was directed toward PI, and it received considerable interest during the 1950's and 1960's as a possible way of alleviating the pressures that were being applied to the field of education by the rapidly increasing student populations. However, PI was found to be rather boring, particularly to average and fast learners, and it gradually fell into disuse. Still, PI had established an important basis for the development of "computer assisted instruction" (CAI) which followed.

In the early 1960's several developmental projects in CAI were begun. One of these projects was produced at the University of Illinois, where the first version of PLATO was created by Donald Bitzer and his associates. This was one of the earliest marriages of PI and computer technology. The PLATO system initially used the ILLIAC computer to present learning sequences that had been prepared by subject

matter specialists using the TUTOR "authoring language." The PLATO system now has thousands of hours of learning exercises and is marketed by the Control Data Corporation.

A second major project in the early 1960's was developed at IBM's facility in San Jose, California, where the IBM 1500 system was produced as an experimental prototype of a comprehensive CAI facility. Using a minicomputer (the IBM 1130), and the Coursewriter II authoring language, the 1500 system included such features as light pens, color image projectors, and computer-controlled audio units, which provided students with high-level learning experiences based on tutorials and simulations. About 30 of the IBM 1500 systems were produced, of which only two were installed outside of the U.S. - one at Laval University in Quebec, and the other at the University of Alberta. The 1500 system has now been retired, but the research and development that it supported showed clearly that computer-based instructional systems could teach effectively.

A third centre of activity in the 1960's was at Stanford University where Patrick Suppes began his research and development work in CAI. This resulted in the generation of computer courseware which today ranges from pre-reading levels to symbolic logic for university students. Suppes' system is marketed through the Computer Curriculum Corporation.

An interesting Canadian development in the field of CAI began about 1970. Under the auspices of the National Research Council (NRC), several people working in CAI were consulted as to the desirable features that should be included in the "ideal" authoring language. From this was developed NATAL, the "National Authoring Language", which for several years was available only on NRC's own computer in Ottawa, but which now has been installed on a number of other computers, including the IBM PC-XT. NATAL is similar in many ways to other authoring languages, such as TUTOR, but it has the advantage of portability across computers from different manufacturers.

Another important development of the 1970's was the LOGO language first proposed by Seymour Papert as a means of helping children acquire geometric concepts and problem solving strategies. The original LOGO was used by students to direct a mechanical "turtle" over a large piece of paper set on the classroom floor. The turtle was directed by a "program" of commands developed by the student, for example, to go FORWARD a number of units, then to RIGHT TURN a number of degrees, etc., to create a great variety of geometric figures. As it moved, the turtle produced the desired geometric figures on the paper by means of a trailing flow pen. Papert, who had studied under Jean Piaget, the noted developmental psychologist, proposed that the actions of the turtle be simulated on a computer's screen, and so LOGO was transformed into a high-level computer language by Harold

Abelson and others at the Massachusetts Institute of Technology. In the computerized adaptation the turtle has become an "arrowhead" on the screen, and the commands of LOGO, as entered through the computer's keyboard, permit geometric figures to be designed and drawn. Most students, as early as kindergarten, are able to control the computer by creating increasingly complex figures with LOGO (Papert, 1980). And, as they program in LOGO, students learn, implicitly, the basic principles of "top-down" problem solving.

II. Microcomputers in the Schools

Overview of the Developing Presence in Schools.

In the late 1970's inexpensive home microcomputers became available. The home hobbyist was the first target for these machines, but Apples, Pets and Radio Shacks soon began to appear in schools. Although the state of Minnesota installed an agency to orchestrate the placement of microcomputers in school and to develop and disseminate educational software, the most typical pattern in 1978 to 1980 in North America was that of an individual teacher becoming a home microcomputer enthusiast and transferring his discoveries, and often his own computer, to his particular classroom. In 1979 a document published by the British Columbia Ministry of Education noted that, "there are, at the time of writing, several schools with microcomputers installed and in use either actively or experimentally in a classroom setting" (Tennant, 1979, p.1).

A variety of events combined almost immediately to escalate the presence of microcomputers in schools. First, the industry itself exploded into a pattern of rapid growth and expansion. Software and other resources, especially for Apple products, established a strong presence in the marketplace. The many people who owned machines began to exert pressure on schools to provide instruction on the use of this new and presumably important medium. This consumer pressure was strengthened by a growing consensus that computers would soon become a central force in the commercial and vocational world.

A number of well-known educators became spokesmen for the cause of providing "computer literacy" training in schools. Reminiscent of the response to Sputnik two decades earlier in the United States, quick acceptance was gained for the view that if a country wanted to prepare its students for the world of the future, computer literacy must be achieved by every student. Andrew Molnar of the U.S. National Science Foundation published a seminal article in 1978 entitled "Computer literacy in the classroom: The next great crisis in American education". Arthur Luehrmann,

Director of Computer Research at the University of California at Berkeley, described computer "illiteracy" as a national crisis, stating emphatically that "the ability to use a computer is as basic, and as necessary to a person's formal education as reading, writing, and arithmetic" (Luehrmann, 1980, p.98). Pogrow identified "technological relevance" as the major educational issue of the Eighties - "the issue whose outcome will determine whether the public schools will continue...or suffer an 'environmental collapse'" (Pogrow, 1982, p.611). From the vocational perspective, predictions began to appear in both the professional literature and the popular press that "before long, ... it is entirely possible that computers will be so pervasive in every aspect of business that only those who use them with facility will survive in the marketplace" (Benderson, 1983, p.2). Against this background, educational authorities in North America, the United Kingdom, and France responded quickly and began to allocate a large commitment of time and money to the general goal of making students computer literate.

Survey of Microcomputers in Schools.

A January, 1983 survey by the Center for Social Organization of Schools at the Johns Hopkins University indicated the extent of school microcomputer growth in the U.S. between 1981 and early 1983. In 1981, approximately 6 percent of elementary schools and 38 percent of secondary schools had computers; by January 1983 these figures increased to 42 percent and 85 percent (Becker, 1983, pp.2-3). Similar figures are available for British Columbia, where all but 2 of the 75 public school districts reported having computers by early 1983, with a total of 2,889 purchased with district or local funds (Jones, Porter, & Rubis, 1983, p.5). The increase of hardware in British Columbia from "several" in 1979 to nearly 3,000 in early 1983 represents an impressive public commitment to the value of computers in education, even more so considering the prevailing climate of fiscal restraint. Table 1 contains data from a recent article in the Canadian journal Computers in Education (Allan, 1984). These data demonstrate the growth of computers in public education throughout Canada.

Uses of computers in education.

The quantity of hardware in schools, as well as the burgeoning activity in teacher inservice, educational research, and commercial educational materials production indicates that computers are being used regularly in schools. An examination of these uses shows a variety of applications and can be summarized in reference to (1) learning about computers, (2) learning with computers, (3) using computers as tools in the school setting, and (4)

applying computers to the education of special groups of students.

Learning About Computers.

This focus, a major one for the use of school computers, involves content such as (1) the history of computers, (2) computer-related vocabulary, (3) computer operating skills, (4) knowledge of uses (and abuses) of computers in society, and (5) elementary programming. There are a number of points of controversy regarding what students should learn about computers. These include:

(1) Who should provide this instruction about computers - computer specialists in secondary school? classroom teachers in elementary school? mathematics teachers? Should every teacher be involved, or only those designated as school resource persons?

(2) Should learning about computers occur within specific computer literacy courses, or should it be diffused throughout the existing curriculum? How should student achievement be measured and evaluated, especially if the information about computers is included within the scope of other courses?

(3) Should programming be taught - to every student? to elementary students? What language or languages should be used? Is LOGO preferable for specific groups of students, such as the very young or those with learning handicaps? Should BASIC be taught? Who should learn PASCAL? Are flowcharts still a valuable aspect of program design? What is the association between programming and problem solving? Can Papert's hypotheses, stating a causal relationship between LOGO programming and cognitive development, be tested or supported?

(4) What should the content of senior secondary computer science courses include? What are the implications of university-level computer science course content and the advanced placement computer science examination for decisions regarding secondary school computer science curriculum? What training is appropriate for a computer science teacher?

There are a variety of responses occurring in schools with respect to each of these questions. In North America, a typical pattern involves the elementary school student in one or two "computer literacy" units. The scope of these units depends primarily on the interest and ability of the individual teacher. No consensus exists as to appropriate content, methodology or measurement standards for student achievement. These elementary school computer units frequently include some BASIC programming. Although LOGO advocates are prolific contributors to professional journals and

conferences, recent figures indicate LOGO to be the language used for programming instruction in only 5 percent of schools (Becker, 1983, p.4). With the relatively small number of microcomputers in the elementary schools, programming experiences are most likely to occur in after-school computer clubs where a teacher-enthusiast is on staff. In addition, programming experiences are more likely to be stressed in schools representing higher socio-economic levels whereas drill and practice activities dominate the use of computers in schools representing lower SES levels (Becker, 1983, p.14).

While frequent, but unstructured, activity characterizes learning about computers in elementary schools, a required computer literacy course or unit is becoming a regular feature of junior secondary timetables. Most typically these courses are locally developed, are taught by mathematics teachers (often as part of the mathematics curriculum), and again reflect little consensus regarding content and methodology. In British Columbia, the Ministry of Education has distributed a list of "Goal and Outcomes for Computer Literacy" which are phrased in terms of computer-related competencies which students should acquire. The presence of the list, first distributed in September 1984, may help to improve the homogeneity of "computer literacy" courses in British Columbia; however, the document does not have the status of a curriculum and does not attempt to assign priorities to its many pages of outcomes. In addition, curriculum has been developed by the Ministry for a new Grade 11 course, called Computer Awareness, and this course is being offered for the first time in Fall, 1984. Finally, the curriculum for Computer Science 11/12, currently included as part of the provincial mathematics curriculum, is under revision.

Contentious issues in senior secondary computer science revolve around programming. University computer science professionals are vigorous in their condemnation of BASIC as a programming language, yet BASIC is the language used in 98 percent of the North American schools where programming is taught (Becker, 1983, p.6). A broader question involves the issue of whether programming should be taught at all. Those who oppose school instruction in programming may cite lack of time and equipment, lack of teacher training, lack of relevancy for many types of students, lack of relevancy for any students given the fast-changing computer language environment, or poor habits developed by improperly taught students.

Learning With Computers.

The major use of computers in British schools is to deliver programs which augment the existing subject matter curricula. This approach to the use of computers in schools

also characterizes approximately half of North American elementary school computer applications but only about 10 percent of secondary school applications, excluding business education (Becker, 1983, p.4; Jones, et.al., 1983, p.11). The dominant practice, when computers are used to augment existing school curricula, is to supply drill experiences in either mathematics or language arts. Research activity in the area of using computers for learning other subjects includes a focus on questions such as the following:

(1) How can software be identified and previewed in order to determine its relevance to existing curricula? How can the criteria used for the evaluation of textbooks and other educational resources be applied to computer software?

(2) What curriculum areas are underrepresented in terms of currently available educational software? What types of learning experiences are underrepresented?

(3) In drill and tutorial software, how well are established learning principles involving reinforcement, questioning strategies, feedback, and stimulus variation implemented? How can software accommodate individual differences in learning style, entry skills, and need for repetition and review?

(4) How can the secondary school subject specialist teacher be encouraged to use a computer to enhance learning in his or her discipline?

A trend seems to be developing in elementary schools to put more focus on the use of the school microcomputer as an agent for learning existing school subjects. Partially this reflects the inability of many teachers to find time or inclination to teach "computer literacy" units which focus solely on the computer. Partially it reflects the philosophy underlying the British model - that students will learn about computers as they use them, and therefore specific lessons about the machines are unnecessary if computers are used regularly and in a variety of ways within the already-full school curriculum. As this use of computers continues to grow, procedures for collaboration between curriculum specialists, teachers, software engineers and programmers must be developed and mechanisms for the generation of software deliverables must be established. The Scottish Microelectronics Development Project (SMDP) and the Microelectronics Education Programme (MEP) in Britain offer models of this sort of collaboration and product delivery. The IBM Software Engineering/Education Cooperative Project at the University of Victoria is in the process of developing this type of collaborative model.

Using Computers as Educational Tools.

As a generalization, the use of computers as educational tools involves either the use of open-ended software as a teaching tool within specific classroom activities, or using the computer for administrative purposes. Questions in this area include:

(1) How can word-processing software be used to facilitate the writing process? Should students use word-processing software for reports and writing activities outside of English classes?

(2) How can database programs be used within social studies and science units? Can the development and use of a database provide relevant experiences in classification and organization processes and in inquiry skills? Should the school provide experiences whereby the student uses telecommunications to access a large external data base for information?

(3) How can computers be used as a tool for the storage and analysis of data, both in the science laboratory and in social studies courses? What sort of graphing program and information handling packages are valuable for the gathering and display of data?

(4) As teachers, administrators and office personnel use computers more frequently for administrative tasks, what balance should be found for assignment of computer resources - how much for instructional purposes, how much for administrative applications?

Currently, schools make little "open-ended" use of computers as instructional tools. More focus on this use as part of the set of suggested teaching methodologies in specific disciplines should be provided by faculties of education and by teacher inservice. However, administrative use of microcomputers is growing rapidly. Many secondary schools now maintain attendance records and other student records on computer disks. In addition, course and student timetabling software is becoming a frequent school purchase.

Using Computers with Specific Student Populations.

Considerable research activity in the broad area of computers in education relates to the impact of computer-based learning on various subgroups of students. Particular interest is given to computers and the handicapped, the use of computers in the learning assistance centre, and issues involving computer equity - encouraging or providing equitable computer-related opportunities for females or for students from schools in lower socioeconomic areas.

The delivery of drill and practice programs for remediation and within learning assistance centres is the most frequent curriculum-referenced use of elementary school microcomputers in North America (Becker, 1983, p.4). Most frequently, this exposure consists of repetitious drill experiences, allowing the student to reach a mastery target at his own rate of progress. Considerable research interest is beginning to develop in this area - How can higher-level problem solving strategies be delivered in the learning assistance context? How can software-based experiences adapt to the different problems of students who need remediation? Is the dedication of a school computer to the subgroup of students needing learning assistance the most defensible choice of uses for a school computer?

Using computers with handicapped learners has been the focus of considerable educational research and development. In Britain, a considerable portion of national funding is given to activity in this area; in the U.S. mainstreaming requirements have prompted similar high interest. Sylvia Weir, at the Massachusetts Institute of Technology, for example, publishes extensively, describing her naturalistic research on LOGO and handicapped individuals. The modification of input and output devices for computers in order to allow communication between a severely handicapped person and her environment is both an exciting and inspirational area of computer-applications research.

While the computer is seen to be an exciting tool for the education of handicapped persons, many are concerned about the tendency of a large group of students to decide, prematurely, that computers offer no interest or value to them. The underrepresentation of females in voluntary mathematics and physical science activities is well-documented in both North America and Britain, and generates considerable research and intervention activities. Similar concerns are now being expressed concerning females and computer studies. Many educators have commented informally on the problem; recently more systematic description has occurred. A consensus is developing that adolescent females are associating negative attitudes of self-confidence and interest with computer-related opportunities. How to respond to this problem is an important consideration in the planning and delivery of computer experiences in schools.

These observations describe only part of the intensive educational activity occurring in the area of educational applications of computers. Preparing the teacher to respond effectively to even a subset of these questions is now an important component of a teacher's professional training.

III. The Response of Faculties of Education

The rapid entry of microcomputers into businesses and homes almost immediately placed pressure on the educational community to pzovide "computer literacy" for pupils at all levels. It became evident that a massive inservice effort had to be mounted to provide those teachers who were willing to respond to the challenge by acquiring at least the basic rudiments of operating a computer. The task would have been overwhelming were it not for the fact of the economic recession in North America which has more or less coincided with the growth period and which dampened some of the enthusiasm that educational authorities might have had for an early response. The result was that many elementary and junior high schools were obliged to raise funds themselves for the purchase of microcomputers, and hence the period of introduction was more gradual than it might otherwise have been. Regardless, faculties of education were called upon to provide inservice as well as preservice training in the use of computers which many, if not most, were not immediately equipped to do.

Microcomputer laboratories were hurriedly built and the first inservice workshops were presented, usually on a non-credit basis. These were followed by credit courses at the undergraduate level for practicing teachers, both on-campus and in the schools. As evidence of this, a 1982 survey made of 740 faculties of education in the United States showed that 63 percent offered some kind of computer education component within the teacher education program (Kull & Archambault, 1984, p. 17). The modal pattern was three or four credit courses combined with non-credit workshops, summer institutes, and minicourses. In addition, approximately 10 percent of the surveyed faculties reported the inclusion of computer instruction in existing methodology courses. The outcome of these initial efforts was the establishment of small groups of knowledgeable computer-using teachers in most school districts.

As active as this teacher education has been however, few institutions in North America have the extensive programme offered at Jordanhill College of Education in Glasgow, Scotland. With a 28-member computer education faculty, postgraduate degrees in computer education are offered as well as teacher certification specialty diplomas. In addition, all students are required to take courses in computer applications and receive instruction in the use of computers in each of their teaching areas. Extensive inservice throughout Scotland is also offered by the College and an active research and development programme exists.

In North America, graduate programs have been developed for those teachers who were deeply immersed in the use of computers, and who wanted advanced training. These graduate

programs have tended to deal with the more theoretical aspects of learning with computers, with models of implementation, and with the broad range of applications of computers in the classroom. Graduate students, particularly at the master's level, have produced a great number of practical materials in the form of learning programs and teacher's manuals which essentially document the specific activities and materials that they have used in their own classrooms.

An interesting graduate programme has been developed at Stanford University. The programme is chaired by Decker Walker and offers the master of arts degree in "interactive educational technology". Candidates for the degree must have advanced training in three areas: computer programming, education, and psychology. The requirements for the degree include the analysis of an educational problem, the design of a computer-based plan to address the problem, the subsequent design and coding of computer software to implement the plan, and the field testing and evaluation of the plan in a classroom setting.

Finally, research activity is escalating at the university level. Doctoral-level research, which addresses the more abstract features of computer use, including attitudes, motivation, and learning styles, is now being published. (It is interesting to note that Dissertation Abstracts do not yet include computer applications as a subject-area descriptor.) Faculty members, too, are busily engaged in attempting to provide a broader understanding of the role that computers can and should play in the schools.

IV. Opportunities at the University of Victoria

Currently, the University of Victoria offers two upper-division credit courses in the Faculty of Education which relate specifically to computers in education. These courses, ED-D 338 and ED-D 438, have teaching certification as a prerequisite and are taught by faculty members in the Department of Psychological Foundations in Education. Some sections of these courses are also offered off-campus. The courses are now in their third year and continue to be fully subscribed. In addition, students taking the professional year (4th or 5th year students) must complete a series of lab experiences involving the operation of different audio-visual tools and a component involving some minimal operating skills associated with the Apple microcomputer is one of these experiences. Other than these, there are currently no other coursework opportunities unless a graduate student can enlist one of the qualified faculty members for a directed studies or special problems course.

Education Extension coordinates the off-campus delivery of the credit ED-D 338 courses and in addition organizes teacher inservice workshops and a series of non-credit short courses in various aspects of "computer awareness" for teachers and parents. Education Extension, with the Faculty of Education and C.U.E.B.C. (the B.C.T.F. Computer Using Educators professional association), mounts a yearly conference on the impact of computers in education. The fourth annual conference will be held in May, 1985. Last year, the conference attracted approximately 200 teacher-delegates from throughout and beyond British Columbia.

The Curriculum Library in the Faculty of Education houses four Apple microcomputers for student use, including one with a graphics tablet placed in a prominent location in the library. Some educational software has been purchased for use in the library; this software includes the entire MECC collection. In addition, the library is currently acquiring all of the software recommended for use in the Greater Victoria School District as part of a new scope and sequence plan adopted by the district.

A valuable new resource for the Faculty of Education is a laboratory with four or five IBM microcomputers and a printer. Donated as part of the IBM Software Engineering/Education Cooperative Project, the laboratory will be used for faculty research and development projects.

While all of this activity represents a reasonable spectrum of opportunities for education students and teachers interested in computer applications in education, a number of additional training and research components can be suggested.

(1) Additional courses could be offered within the Faculty of Education and would draw an immediate student audience. These courses could include:

    (i) Issues in policy and planning involving microcomputers, a graduate level course for students in educational administration.
    (ii) Computers and special education, a course for students acquiring a specialty area in the education of exceptional students.
    (iii) Educational software design, a graduate course similar to those offered as part of the master's program at Stanford University. A focus of this course would be to train educational professionals in the design of instructional software and support materials.
    (iv) A methods course for teachers wishing to teach computer science in secondary school. While methods courses are offered as training for every other discipline, only

Stanford University in North America and Jordanhill College in Scotland are known to offer specific training in methods of teaching secondary school computer science.

With courses such as these, a master's programme in computer applications could be offered. Two directions of study could be immediately developed within such a programme - one which would identify research-oriented questions involving the interaction of computers and different groups of students in the context of learning theory and educational psychology, and a second which would focus on the needs of a district or school computer coordinator, including training in curriculum development and programme evaluation.

(2) A software preview and evaluation area could be created for student and teacher use. A model exists at St. Martin's College in Washington State, a small, private college which has established a resource centre with more than a dozen microcomputers. Financing is found to pay attendants and to regularly purchase commercial educational software. Teachers wishing to use the centre to evaluate software pay a small user's fee.

(3) Each methods instructor in the Faculty of Education could participate in a collegial "training session" where he would become familiar with computer applications in his particular area and in turn would include these applications as part of each methods course. Jordanhill College in Scotland requires such updating of all of its education faculty and includes this peer training as part of the teaching load of some of the computer education faculty.

(4) Research involving computers in education could be encouraged by the development of a mechanism whereby the work of each faculty member involved in a computer-related research project could be made known to the rest of the faculty. Currently there exists the possibility of duplication of efforts or equipment because of lack of knowledge of each other's interests. The IBM/University of Victoria project has the potential to facilitate such communication. The recent collaboration of education faculty and law faculty in the delivery of a workshop on computers in legal education was possible because of the use of the IBM Software Engineering laboratory and is an example of the potential of interfaculty research activities.

The opportunity clearly exists for the University of Victoria to achieve a leadership position throughout Canada

In the area of educational applications of computers. The IBM/University of Victoria Cooperative Project has considerable potential to strengthen the basis for this leadership; along with steady growth in course offerings and research the University could help to reassert a strong academic foundation to the use of computers in education.

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Table 1

Computers in Canadian Public Schools

Province	Computers: 1984	1983	Percent Increase	Student Enrollment (1984)	Computers/ Student
Alberta	6000	3535	70%	450,000	1/75
B.C.	3800	2500	52	478,000	1/126
Manitoba	1610	1610		201,386	1/126
N.B.	1250	1000	25	125,000	1/100
Nfld.	500	200	150	145,000	1/290
N.W.T.	168	N/A		12,000	1/72
N.S.	1000	800	86	175,778	1/176
Ontario	9000	8000	12.5	2,000,000	1/222
P.E.I	200	150	33	25,000	1/125
Quebec	1500	800	86	1,000,000	1/667
Sask.	2000	1500	33	200,000	1/100
Yukon	84	N/A		4,200	1/49
Total	26,861	20,095	34	4,816,364	1/201

Note. 1984 figures not available for Manitoba.

From Allan, R. (1984). School computers in Canada. Computers in Education, 18-19,31.