COMPUTERS IN PRE-COLLEGE EDUCATION: OREGON MOVES FORWARD

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The computers in education field is making rapid progress. We can see this progress in the quality and number of data processing programs at the associates degree and data processing school levels, and in the bachelor's, master's, and doctorate programs at colleges and universities. We can also see large numbers of secondary schools beginning to acquire computing facilities. But we have a long way to go! To put our current progress in perspective we need merely ask: "What percentage of students in the United States made direct instructional use of computers during the past week, how extensive was this usage, and how effectively did it contribute to the student's education?"

GOALS FOR COMPUTERS IN INSTRUCTION

The computers in education field can be divided into administrative, instructional, and research uses of computers. Many applications overlap two, or even all three of these categories. However, in this paper we will focus only upon instructional uses of computers.

Computers should be used in instruction to further the overall goals of education. More specifically, instructional use of computers can be divided into teaching using computers and teaching about computers. Ideally there should be appropriate and adequate computer facilities, teacher and administrative knowledge and support, instructional materials, etc. so that:

1. All students acquire an appropriate level of knowledge in the computer science field.
   a. All students should become "computer literate" at a level commensurate with their overall level of education.
   b. All students having a personal and/or professional need for additional knowledge in computer science (such as computer programming) should have adequate opportunity to gain the desired skills and knowledge.
2. Teaching using computers (computer assisted instruction, computer augmented learning, and computer managed instruction) would occur whenever computers are an appropriate and educationally sound aid to the overall instructional process.

FACTORS RELATED TO GOALS ACCOMPLISHMENT

There is no simple, magical route to accomplishing the goals for computers in instruction. The problem is complicated, and many interrelated factors are involved.

1. Hardware and software facilities.
2. Teacher and administrator knowledge.
3. Instructional materials.
4. Planning, research, and evaluation.
5. Information dissemination.

If a school, school district, or state is successful in all five of these areas it will achieve the goals we have suggested for computers in instruction. It should be noted that tradeoffs can occur between some of these areas. A well trained teacher can make do with relatively poor materials and only moderately good hardware and software. With appropriate planning and leadership a school can "make the most" of what it has in terms of hardware, software, trained teachers, and materials. A poorly trained teacher cannot be an effective recipient of information from a typical information dissemination system.

HOW OREGON MEASURES UP

Using this 5-point framework for measuring progress in computers in instruction, let us now turn to the situation in Oregon's public schools.

Hardware and software. Instructional computer users at the pre-college level in Oregon are serviced by three regional time-shared networks, a small amount of access to university level computer networks, a number of minicomputers, a few batch processing systems in school offices, business, or nearby colleges, and a few miscellaneous access methods such as via US mail. The major facilities available are three regional time-shared systems and a number of stand alone mini-computers.

In the Portland area, the only really large city in Oregon, there is a time-shared system based upon two Hewlett-Packard 2000 series computers each capable of handling 32 active terminals. This system provides time-shared BASIC to every public secondary school in the area, as well as to a few elementary schools.

Eugene is the home of the Oregon Total Information System (OTIS) computers. An IBM 360/50, a TEMPO (switching computer) and a 32 port Hewlett-Packard 2000 series computer service the needs of the school management information system as well as some of the instructional needs of seven counties (about 1/5 of Oregon's total population). The Hewlett-Packard provides time-shared BASIC for instructional purposes to the secondary schools in the Eugene area and is also extensively used by several schools in eastern Oregon, a few schools located on the coast, and a few other widely scattered schools. Pendleton High School in eastern Oregon, located 240 miles from Eugene, is a big user of the Hewlett-Packard system.

A newly started network (again based upon a Hewlett-Packard 2000 level computer) serves 8 secondary schools in the relatively sparsely populated Rogue Valley area of southern Oregon. An intermediate education district in that area passed a resolution budget of $25,000 per year to provide their schools with time-shared BASIC.

Most of the minicomputers used in Oregon's secondary schools are PDP-8's. The number in use is relatively small--certainly less than a dozen, and these are fairly widely scattered. In the Salem area three of the high schools have PDP-8's and also make use of time-shared facilities at Oregon State University. Sparsely populated Lincoln County on the coast has a PDP-8 system with one hard-wired and one dial-up port.

We will not go on to detail further facilities. It suffices to say that somewhat over half of Oregon's secondary school students have some instructional access to computers. Most of this access is Hewlett-Packard time-shared BASIC or an in-school PDP-8 with its BASIC and other languages. None of this computer access came about as a result of a statewide effort or from financial support at the state level. Rather, it came about through the work of local schools and districts, using primarily funds generated at the local level.

Trained teachers. The situation in Oregon may well be the best in the United States. (If so, the nation certainly has a long way to go!) Oregon's progress here can be laid almost entirely to federal funds. I will list a few of the major teacher training efforts that have occured.

During 1966-1969 a federally funded Computer Instruction Network in the west central part of Oregon carried on extensive teachers training, materials development, and other pioneering activities. More than 10% of the secondary schools in the state were involved. Computer access included an IBM 1130 in a mobile van, two PDP-8's which were moved from school to school, and time-sharing on a commercial General Electric system. A major emphasis in this project was getting teachers trained to a level so that they could use computers in their classrooms.

A second major influence has been the Northwest Regional Educational Laboratory located in Portland. They have developed and extensively tested project REACT materials, which included courses for teachers and administrators, teaching materials for teachers, and materials for students. The NWREL continues to make significant contributions in these areas.

The National Science Foundation summer institute program has been very good to computer education in Oregon. A computer science summer institute was held at Portland State University for a number of years; during the past six summers the NSF also supported a computer science summer program at University of Oregon in Eugene. Almost every Oregon teacher who cared to apply for a summer institute in computing got the chance to participate in one of these programs. Of course, only a small percentage of all teachers in the state actually applied; the point is, the opportunity existed for those who were interested.

Using federal funds a computer literacy course for teachers was developed at Oregon State University. This course was offered through the state Division of Continuing Education, using television for most of the presentation, and reached several hundred teachers. The course has been used a number of additional times with smaller groups.

Local districts have funded some in-service work. In the Portland area, for example, in-service work for teachers has been available each year since before their computer network was started.

Currently the dominant influence in teacher training is the activities carried out under the NSF "systems" grant for mathematics education in the state of Oregon. About $100,000 of this million dollar grant was spent on computer related activities during 1972-73. One of the major programs funded was an 8 week teacher training and leadership development program at the University of Oregon during summer 1972 in which about 40 Oregon teachers took part. Seven of these teachers conducted in-service courses in their own school districts during the next year. This reached teachers in seven widely scattered, rather low population areas, where conventional in-service programs rarely reach.

In addition to running that summer program I also conducted an in-service course each quarter during 1972-73. Teachers came from a radius of about 60 miles, and for the first time this type of training began to reach a significant number of elementary teachers, social studies teachers, etc. A similar in-service program in the Rogue Valley area of southern Oregon reached about 70 different teachers in the spring of 1973. The NSF "systems" funds have also been used to train teachers in the use of the Colorado Project materials (a second year algebra and trigonometry course which makes extensive use of computers). A 1972 summer workshop for the Portland area and a 1973 summer workshop for the Eugene area have helped to get this course started in about 10% of the state's public high schools.

The NSF "systems" grant has continued during 1973-74 but at a lower level of funding. This past summer 41 Oregon teachers participated in an 8 weeks summer program in computer science at the University of Oregon. Shorter summer programs were conducted at four other points in the state, along with extensive follow-up in-service programs.

I want to brag a little about the teacher training activities that are going on at the University of Oregon. For summer 1973, the department completely redesigned its summer program specifically to fit the needs of teachers. This redesign allows us to offer a master's degree in computer science education to teachers who can attend a sequence of summers. The program has been further improved for summer 1974. Teachers at all grade levels, and with a wide variety of background and experience, can find good course offerings to fit their particular needs.

During academic year 1973-74 the University of Oregon is offering two different year-long courses in computers in education. One is a service course designed mainly for graduate students or advanced undergraduates in education who have had no previous training in the computing field. The second course is designed for more advanced students, who have extensive background in computing and in education. Four of the students in this course are well along towards completing their Ph.D.'s in our computer science education program. This program is carried jointly through the College of Education and the Department of Computer Science. It is helping to produce some of the computers in education field experts that are so desperately needed.

The teacher training program in Oregon is based upon a two-pronged approach. The schools of higher education--especially the University of Oregon--are providing the advanced training teachers need to become resource personnel in their schools and districts. Lower level training is then becoming the responsibility of these individuals in their own schools and districts. This occurs through formal in-service courses and through one-to-one contact between teachers.

Instructional Materials. There are very few good quality instructional materials designed to aid in the instructional use of computers at the pre-college level. It is not difficult to see why. The commercial market has barely begun to develop, and is highly fragmented. Within a single school the computers in instruction activity tends to change drastically from year to year. Within a school district it is difficult to find two schools doing the same things in the computer field.

There have been various materials development projects in Oregon. Best known are the REACT materials of the Northwest Regional Laboratory which we discussed earlier. A federally funded project at Oregon State University produced problem sets, a teacher course, and other resource materials for teachers. This past summer the students and faculty in the University of Oregon computer science program produced a Computers in Education Resource Handbook. (1) This Handbook is a fairly comprehensive and up to date overview of the computers in education field, and contains a great deal of material specifically designed to aid teachers and administrators.

Planning and research. The State of Oregon itself has provided almost no leadership for its teachers and administrators involved in the computing field. Thus the Oregon Board of Education employs a mathematics specialist, a science specialist, a large group of career education specialists, etc., but nobody whose major area of competence is computers in education. The Oregon Board does attempt to gather statistics on statewide enrollment in various courses. However, the figures it quotes on enrollment in computer related courses are clearly inaccurate; this suggests that good statistics are hard to obtain.

The leadership void has been filled to a large extent by the teachers and administrators actually involved in the instructional use of computers. Several computer-interested administrators in the Portland area laid the groundwork for the computer network that exists there now. One full time instructional computer expert is employed at the county Intermediate Educational District level in that part of the state. Lane County Intermediate Educational District, which owns and runs the OTIS system, employs a full time computer instruction specialist. A few other regions in the state have teachers with partial release time to provide computer education leadership.

A big gap filler has been the development of the Oregon Council for Computer Education. The OCCE is a professional organization of teachers and administrators interested in the instructional uses of computers. It currently has about 150 members; its executive committee represents Oregon education both geographically and by education level, and holds full day meetings almost monthly. The OCCE executive council attempts to isolate and address the major problems of instructional computing in the state. It has been partially supported by a small grant from the NSF "systems" grant for mathematics education in Oregon.

Information dissemination. Information dissemination on a statewide basis has been sporadic, but good progress has been made. The Oregon Council of Teachers of Mathematics publishes a monthly newsletter that is distributed to all 1000 elementary schools in the state, to all secondary mathematics teachers, and to a number of college and university mathematics teachers. For the past two years one page of this has been devoted to computer instruction information. This year the format is a page titled COMPUTERS IN OREGON EDUCATION divided into two columns. One column is short news items of possible general interest to teachers. The other column features a person who is a leader in computer education in Oregon, and the activities this person is involved with.

The OCCE publishes a newsletter for its members. It also holds a yearly conference in conjunction with the Oregon Association for Educational Data Systems, and has a symposium on Computers in the Curriculum scheduled for 26 January 1974. OCCE has set information dissemination as one of its major goals. It has helped run several workshops for school administrators, provides free consulting service to schools trying to get started in using computers, and provides speakers for meetings. The big push on the speaker tour has been in conjunction with the mathematics education activities being fostered by the NSF "systems" grant in the state. Each mathematics conference has a substantial component of computers in instruction activities and talks.

Information dissemination is also done through the other professional publications, such as the newsletter published by Oregon teachers of science. Considerable room for progress still exists in these areas, however.

A key factor in effective information dissemination is that the recipients be able to understand the information to be disseminated. The extensive teacher training program in the state has helped here. Each teacher training program also has built-in a large element of general information dissemination. Participants in these programs are given insight into the statewide computing activities and sources of additional information.

THE FUTURE

I have attempted to paint a picture of solid and orderly progress. Actually, Oregon has a long way to go.

Hardware and software. The current hardware access amounts to about one terminal per 1000 students, in the schools that have computer access. A ratio of about one terminal per 100 students would be more appropriate.

The major language that is available is BASIC. This language is not too well suited to teaching the concepts of structured programming, or writing structured programs. The language lacks some of the desirable features that modern computer science has to offer. Moreover, it is not standardized. This adds to the difficulties of information dissemination and in the preparation and distribution of instructional materials.

There is still a paucity of good library programs designed for instructional purposes. The Huntington II Project simulations are good examples of the type of material needed. There is need to develop hundreds of high quality, well documented programs and related instructional materials.

Teacher training. Many problems exist here. There is no agreement yet on appropriate levels of pre-service training, and most colleges and universities do not offer appropriate courses for teachers. We have not reached a significant fraction of the non-mathematics teachers. For example, it is often suggested that a computer literacy course should be offered by social studies teachers and/or be offered at the junior high school level.(2) Almost no social studies teachers have the computer knowledge to handle such a course, and few junior high school teachers have gotten into the computing field. We have not yet decided what role computers should play at the elementary school level, and almost no elementary school teachers are computer literate. Thus our elementary school children continue to get their introduction to computers via Saturday morning television programs and science fiction movies.

Instructional materials. Progress here is slow. An occasional good film, a few good computer programs, a new course such as the Colorado Project 2nd year algebra course--each helps some. The costs of developing good materials are large. Because of the overall lack of agreement on where the computers in instruction field is going, and lack of standardization of courses, hardware and software, the costs of a materials development project cannot easily be spread over a large group. It seems likely that progress will continue to be slow for many years to come.

Planning and research. The Oregon Board of Education has yet to recognize the importance of computers in instruction. A few school districts employ computer instruction specialists, but most don't. Few districts or individual schools have well thought-out plans of where they are going, or why.

These problems, of course, exist also on a national level. We see some leadership coming via the choice of CAI projects to test on a wide scale or materials development projects that are funded. The Conference Board of School Mathematics has recommended a computer literacy course at the junior high school level. But many fundamental questions have not been addressed. To cite one, people working with project LOGO are very enthusiastic about the idea of teaching computer programming at the elementary school level. This, along with CAI and CMI, could produce a revolutional change in our elementary schools. Little guidance from a national or federal level exists in this area, and little progress is occuring in exploiting the combination of these potentials.

Information dissemination. When the Oregon Council for Computer Education was in its first year, it addressed the question of effective information dissemination in Oregon. It became clear that a reasonably effective scheme would cost several hundred thousand dollars per year. It would involve extensive one-to-one and small group interaction, as well as formal teacher education. This sort of money does not seem to be available, even on a short term basis!

On a higher level, dissemination of information on a nationwide basis is very poor. The problems here are immense, and the most obvious solutions are usually quite expensive. Of course the failure to have effective information dissemination is also very costly over the long run. It slows down progress, and causes much unneeded duplication of effort.

CONCLUSION

The rate of progress we make in the instructional uses of computers will depend upon how many resources we put into it. A single person, working in his school or school district, can still make very significant contributions. A single federally funded project, such as the Huntington II Project, can have a nationwide impact. The rate of progress will tend to accelerate as we develop a larger base of trained teachers, better materials, a better sense of direction, and as computer hardware suitable for school use becomes cheaper. The future looks bright--provided we all keep working at it.

1. Computers in Education Resource Handbook, Department of Computer Science, University of Oregon, Eugene, Oregon 97403. Published in 1973, 596 pp., price $10.

2. Recommendations Regarding Computers in High School Education, Conference Board of the Mathematical Sciences, April 1972.

3. "A Comprehensive Annotated Bibliography on Computer-Assisted Instruction," Computing Reviews, Vol. 14, Nos. 10, 11; 1973.