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Directions for educational computing and implications for professional skilling requirements

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The rise of the personal computer has resulted in significant changes in the way education is using computing. It has also expanded dramatically the range of users of educational computing. This paper discusses the trend away from the old CAI-style computing based on centralised mainframe architecture, specialist staff, and drill or tutorial programming. New directions discussed include decentralised systems based on PCs rather than mainframes, spread of computing expertise throughout staff, and proliferation of higher-order uses for computers such as simulation, problem solving, and training in real-life applications based on business and commercial software packages. Implications for training needs for education professionals are pointed out, including the need for professionals to assume significant responsibility for their own continuing personal development of current computing skills.

Computer technology is probably the fastest growing and developing technology available for instructional use. New hardware configurations with increasing sophistication and capability, and innovative new software are continuously entering the education, business and home use scenes.

Investment in computing systems is increasing annually in all sectors of education, and across all curriculum disciplines, as the axiom "If you can't compute, you can't compete" gains credence in contemporary society.

At this point, there is no longer any argument that computing technology is a powerful and necessary tool for education. There is, however, still question as to how this tool can best be used. The answer to this question must be a major consideration for those concerned with the future of educational technology. This paper looks briefly at the origins of computing in education, its traditional uses, and some directions or trends which seem to be currently emerging in educational computing.

Computing technology made its entry into education in the form of a very expensive arrangement for electronic tutoring and drill. This electronic tutoring was generally referred to as CAI (computer assisted instruction), and was merely a computer based version of individualised programmed instruction. While some CAI programs were reasonably sophisticated in their use of computer graphics and data manipulation capacities, most made little use of the machine's unique analytical, simulation and problem solving capabilities.

CAI was soon joined by CMI (computer managed instruction), which used the computer as an information management system, enabling teachers to cope with the testing and record-keeping demands of individualised instruction. The primary functions of CMI programs were test generation; test scoring; and the storage and manipulation of module completion records, test results, and other measures of student progress and achievement.

The operation of CAI and CMI programs were generally monolithic in nature, and functioned on the talents and know-how of a relatively small number of "computer experts."

In these early days of instructional computing, there were "the school computer centre," and "the computer teachers". "The computer centre" was driven by a large mainframe machine which controlled hosts of satellite "dumb" terminals. "The computer teachers" were a small group of skilled specialists who had qualifications in computing science and who were the only people on campus who knew how to drive the systems on which both administrative and instructional computing was delivered.

In the educational technology field, there were a few hardy individuals who chose to obtain specialist training and experience in computing and then ventured into CAI and CMI development and management. Computing skills, however, were not generally taught in most educational technology courses, even at higher degree level; nor were such skills generally expected of most practicing educational technologists.

Today, however, this situation has changed dramatically. First, the rise of the personal computer (PC) has led to the demise of the mainframe as the primary driver of computer-based teaching and learning. Increasing sophistication of networking systems and data communication peripherals and software, along with increasing computing power in new generations of PCs, can be expected to foster a continuation of domination of computer-based learning by PC rather than mainframe hardware.

Accompanying the spread of the personal computer and the range of applications software available for it has been a de-centralising of computing facilities and expertise. The affordability and ease of use of today's PCs, along with the ready availability of a huge range of excellent software packages has created a far wider base of computing interest and expertise than existed during the early mainframe CAI/CMI days.

It is no longer satisfactory to have just "the computing centre" in a school, college or university. There is now demand for numerous smaller special purpose facilities. Similarly, staff are no longer willing to accept "the computer people" as the sole keepers of the knowledge about computer technology and utilisation. Today, "computer teachers" and "computer experts" can be found across all areas of curriculum, and in the management and services sectors of schools as well. The computer is becoming a tool to be applied in all aspects of teaching and of corporate operations, much like overhead projectors, video players, calculators, typewriters, and photocopiers.

Computing equipment and knowledge also extend beyond the computer centre, the classroom, the school itself. Many students of all ages now use computers at home or at work; many more have encountered computers in their daily lives; most realise the extent to which computing has become a part of contemporary society. This situation produces a set of expectations in a large proportion of the clients of education about the use of computers in education. They expect to find computers in schools, simply because computers are found everywhere else.

The implications for educational technologists are obvious. Computing is no longer a subject which can be selected by those who are interested. It is, rather, a basic and fundamental component of the skills/knowledge repertoire for all members of the profession.

In order to function effectively in schools and universities, it can be expected that all educational technologists will increasingly need to be able to operate computing systems themselves, to maintain current knowledge of hardware and software available, to provide leadership in computing development and training, to analyse both instructional and management computing needs and options, and to participate in decision making about computer applications and solutions in their workplaces. When all teachers and educational managers are finding it necessary to develop computing skills, it is impossible for an educational technologist to function without them.

Implicit in this growing professional competency requirement for educational technologists is a requirement for increasing emphasis on computing in their training programs, both pre-service and in- service. Courses intended to prepare new educational technologists and to update the skills of practicing ones will have to provide expert and appropriate instruction in computing, plus the facilities for hands- on experience. This is a commitment of both human and materials resources which will not be easy for trainers to meet, but it must be given immediate and priority effort if professional training for educational technologists is to continue to be worthwhile.

The rapid change and development which characterises the computing field also means that those who would be effective as educational technologists must be committed to continuous re-training, most of it on their own initiative, throughout their professional lives. Individuals who do not wish to make such a commitment would be well advised to avoid the profession.

Another clear set of trends in educational computing with sharp implications for the training and re-training of teachers and educational technologists are the forms which computer-based teaching and learning are now taking. The newer forms which are increasingly replacing the old CAI and CMI models are highly diversified, and demand more careful examination of course objectives and more creativity in developing techniques for meeting them.

The CAI/CMI model of computer-based instruction placed emphasis on the tutorial or drill mode, and on individualised instruction. Those still suffering from what Schiffman (1986) calls a "CAI mindset" may have difficulty seeing that instructional software can be far more than an electronic version of programmed instruction, and that a large terminal laboratory is not the only useful computing configuration. Educational

technologists should be providing leadership to teachers and educational management in looking beyond such a mindset to the newer computer utilisation strategies which are now emerging.

While use of computers in the CAI-style tutorial or drill and practice mode has a place in some educational situations and is likely to continue in limited usage, what is now emerging is an emphasis on other, more sophisticated uses of computers for teaching and learning, such as simulations, problem solving, and information storage and processing.

Educators are now repeatedly making the point that computers have far more important capabilities than merely serving as electronic tutors. For example, Nelson (1979) states that the greatest potential of computers in education is not in providing information, but rather in teaching how to analyse problems. The Education Magazine (1983) cites a report from Johns Hopkins University Center for Social Organization of Schools which is critical of many computer-based programs as boring and repetitious. The report claims that the expense of using computers is not justified if the main use is simple drill. Osgood (1986) is critical of the "electronic page turning" which has been typical of CAI, and supports a more active form of higher order learning for the focus of computer-based lessons. Schiffman (1986) also criticises mere electronic programmed instruction, favouring instead an open minded attitude to the many different types of computing software than can be used effectively in the classroom.

Many examples from recent books, journals and newspaper reports indicate that computer-based instruction in education is indeed moving away from the old CAI tutorial model into more sophisticated, creative, and relevant applications.

Simulations

One computing mode which is gaining attention in education is simulation. Computer-based simulations have the significant advantage of allowing learners to study, investigate and practice complex skills, procedures and concepts in a realistic but non-risk situation. Computers can allow the manipulation of many interrelating variables to observe the effects of changes in some variables on the others and the resultant consequences. Decisions at a realistic level of complexity can be trialed by learners without actual risk to people, capital, or other resources.

Numerous computer simulations intended for educational use have been reported in recent literature. For example, Koltke (1981) reviews a simulation called Tribbles which is being used in schools to introduce the

scientific method. Hawkridge (1983) cites a microcomputer simulation designed by secondary students to train travel tour operators. While operating the simulation, trainees must learn about advertising, hotel/resort selection, pricing policy, air charters, and retail outlets, while allowing for such factors as national and international economic variations.

The Chelsea College of the University of London has released several micro simulations which are being used in schools in the United Kingdom. These include an economics model aimed at the senior secondary level, and a simulation examining the factors influencing home heating requirements and costs. Some secondary schools in the United Kingdom are also now using a simulation produced by the Geography Association Project at the University of Leicester which deals with urban land use, transport networks, and location of settlements.

Closer to home, recent news reports from several Australian schools indicate the use of computer simulations. For example, Salisbury High School in Adelaide is using a bank of microcomputers to train students in a simulated automated office. The marketing courses at the new Ultimo campus of the New South Wales Institute of Technology make use of simulation-type exercises to give students experience in using a PC in marketing strategies, market research, and product scheduling. Several secondary schools in Melbourne report that they are trialing a new simulation game program for the Apple Macintosh called Balance of Power. This program teaches the complexities of world politics economics and power struggles through the processes of using research materials, correlation of information to achieve objectives, and interpreting and forming relationships.

If the trend toward simulation exercises continues, this will be a significant new area of skill development for educational technologists and for teachers. Necessary knowledge will include hardware analysis and selection, software availability and selection, principles of simulation and simulation gaming, and instructional techniques for integrating computer based simulations into curriculum. Applied with appropriate knowledge and skills, computer simulations can be an excellent example of what Schiffman (1986) calls "software infusion", ie. the use of carefully selected computer software to enhance the teaching of specific curriculum objectives.

Training on Applications

Probably the strongest trend in computing which has arisen from the rapid and universal rise of the microcomputer and its range of software is what can be called "application training." Learning to use a PC for business and real-life purposes is currently, and is likely to continue to be, among the skills most frequently sought by students at all levels, and by the general public.

Application training in the use of programs for word processing and its new relative "desktop publishing," creating and analysing data bases, spread sheeting, financial management, graphics, project management, idea processing, new industrial tools such as CAD/CAM, etc. is now among the subjects most requested by education client. This use of the capabilities of computers to aid in dealing with information and making decisions applicable to real life situations brings educational computing a long way from the electronic tutoring which characterised most early CAI. Further, it is based not on special "educational courseware," but on off-the-shelf commercial software packages - the same packages that are actually used in business and personal decision-making and information handling outside the classroom.

In mid-1984, comments by visiting experts from the United States and the United Kingdom (see The Age, Tuesday 5 June and Tuesday 7 August, 1984) made it clear that there is strong feeling overseas that computing in education should mirror the outside world more closely, that skills in using application packages are becoming an increasingly important skill, that the most useful and versatile software programs are off-the-shelf commercial packages, and that most "educational software" is of poor quality and a waste of time outside specific computer education classes.

Any review of instructional computing currently being implemented in Australia will show that the trend to application training and use of commercial software packages is now strong throughout the country. Newspapers now contain advertising from dozens of colleges and universities of short courses on well known packages such as Lotus 1-2-3, Framework, Multimate, dBase III, Open Access, Multiplan, etc. Many institutions are discovering that their students are demanding micro laboratories, not for CAI or CML, but for word processing, data base development and utilisation, statistical analysis, and other common

applications in the preparation of their assignments. Some have even installed new laboratories specifically for assignment preparation and general usage by students.

Many examples of Schillman's (1986) "software infusion" are also appearing in recent reports of special computer-based projects in Australian schools, colleges and universities. Most of these are based on commercial application software, and stress the use of micro computers as tools for learning, investigating and communicating.

These examples include using word processing packages in creative writing and journalism; using modems, satellites and communication software in "discussing" social issues with fellow students in other countries; using spreadsheet programs to study trends in GNP and inflation; using database programs to prepare and analyse local weather patterns and economic structures; and using graphics and desktop publishing packages to produce student newspapers and creative writing anthologies. The examples available are legion, and one need only look in a local newspaper or education journal to confirm this.

In the administrative and management area of education, application programs are also making their presence felt. Administrative staff are learning the values of office automation, electronic mail, personal word processing, and institutional data basing, and are looking for leadership in the development and use of computing systems.

The resultant implications for educational technologists are clear. Wide and current knowledge of available hardware and software, and of the creative uses which are possible for them in both instructional and administrative branches of educational computing, will become increasingly important if educational technologists are to remain credible and worthwhile advisers and leaders in instructional development.

Conclusions

This paper has summarised what are currently, and are likely to continue to be, major trends in educational computing, as well as the implications for skilling and re-skilling teachers, school administrators, and educational technologists in the coming years. Computing is likely to be a primary resource which clients of all ages will expect - even demand - be utilised fully and effectively in all areas of education. Computing skills relevant to their particular field will become mandatory for teachers, and appropriate skills will be required of administrators and service personnel. If

educational technologists wish to play a leadership role in this situation, then both breadth and depth of current computing skills must become a significant component of their professional preparation and of their continuing professional development.

The implications for those who offer preparatory programs for teachers, and especially for educational technologists, are also clear. In a time when human and materials resources are constrained in education, it will be necessary to find ways of providing appropriate computing training. This will not be a simple task, but it is one which must be addressed, and very soon.

Part of the responsibility for providing computing equipment and training may well have to be placed on and technologists themselves. Requiring that educational technologists purchase a PC and software for their own training and use is not without precedent. Many no doubt already own them. Those that do not and are unwilling to purchase such equipment can bear in mind that students in many engineering, marketing and accounting programs are already required to do so. When the computer is a professional tool, professionals must be willing to be responsible for its provision.

Significant responsibility for acquiring required computing knowledge and skills on an on-going basis must also be assumed by technologists and teachers. Given resource difficulties and the rapidly changing information base of the computing industry, it is now and will continue to be impossible to provide adequate formal training and retraining. Those who wish to keep pace with what is required of them to perform effectively in schools, colleges and universities must be willing to make a real commitment to continuous training updating, largely through personal initiative, throughout their professional careers. Now, more than ever before, this "comes with the territory" for educators.

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