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CJEC Special Issue on Teacher Education and Technology

David A. Mappin
Guest Editor

As the Faculty of Education at the University of Alberta concludes its year celebrating its fiftieth anniversary, it is with some pride we present this special issue on Teacher Education and Technology. There has been interest in innovative instruction and the possible application of technology to education in our Faculty since the time a School of Education was created at the University of Alberta in 1929. A portion of this early history, particularly as it relates to the work of M. E. LaZerte, the first Director of the School of Education and later the first Dean of Education, is related in this issue in the paper by Steve Hunka and George Buck.

The early interest in technology in the Faculty of Education at the University of Alberta has continued to the present day, but it could not be said that technology has become an integral part of education, or of teacher education. There continue to be a number of faculty members actively interested in the concepts and practices inherent in technology and the possibilities of using technology for learning, but they are a small number compared to the ubiquitous use of technology in all aspects of North American life.

However, neither this editorial nor this issue is intended as a platform for launching yet another tirade against the reluctance of teacher education institutions and education generally to be more proactive in utilizing the potential of technology for learning. What is intended is to explore some dimensions of technology as they pertain to education, and hopefully, provoke some dialogue regarding what the relationship of technology and teacher education should be and how that relationship might be realized.

In discussing technology and education there is the fundamental problem of agreeing on definitions of technology and educational/instructional technology. For some it is simply the tools for communicating; a toolbox containing the projectors, monitors, computers, cameras, videocassette players, and the slides, films, videotapes, laserdiscs, and computer programs which are displayed with them. Some extend educational/instructional technology to include descriptions of instructional strategies and instructional tactics which incorporate these tools, as well as the tools themselves.

Others expand the idea of technology further into descriptions and explorations of a field we call educational technology which in its classic definition by the Association for Educational Communications and Technology (AECT) "is a complex integrated process involving people, procedures, ideas, devices and organization, for analyzing problems, and devising implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning" (1977, p. 12). This broad definition is generally associated with ideas of systematic instructional design. Still others have used the term instructional technology to refer exclusively to the processes, production, and delivery of learning events involving computers.

Outside of a strictly education context, technology has been defined by Galbraith (1967) as "the systematic application of scientific or other organized knowledge to practical tasks" (1967, p. 24) and by Forbes as "the product of interaction between man and environment, based on the wide range of real or imagined needs and desires which guided man [humans] in his [their] conquest of Nature" (1968, p. x). The first of these definitions presents the idea of systematic approaches to problem solution, and the second suggests the relationship of humans with nature, specifically in desiring to control nature. This desire has characterized sociological and philosophical considerations of technology for decades. Writers such as Leiss (1991), Franklin (1990), Ellul (1980,1964), and Marcuse (1964), have reasoned about the larger, and in their writings primarily negative, impact of technology on humans and on their society. Others, like Toffler (1981, 1971), Masuda (1980), Papert (1980) and Bell (1973) have argued a more optimistic (and more populist) picture based on a more adaptive and positively creative vision of humanity.

Some of these more general views, particularly the negative ones, have influenced the attitude of many educators towards technology. Phrases such as "technical rationality" are often used to present their arguments, arguments primarily based in ideas of machines and mechanical connectivity held over from the past century. These criticisms deny the complexity of the biological and electronic metaphors which now pervade technology. They also fail to recognize the influence of cognitive psychology and the newer approaches to sociological and educational thought on educational technology and instructional design.

A single issue of a journal cannot present all of these facets of technology, the discussions around them, and the multiplicity of ways they relate to education. This issue is, perhaps, as notable for what is not present in the five papers which comprise it, as for what is. Some of these absent, but readily recognized, dimensions and issues continue to be important, even if neglected or only partially explored.

One of these absent dimensions is media education, the new iteration and extension of what used to be called visual literacy. It is one of the areas of technology which should be crucial to education in today's world and yet it seems to have been a curriculum priority only in Ontario. It might be said that discussions with educators involving the role and importance of media are often more firmly rooted in conclusions solely derived from anecdotal evidence, an educational form of aesthetic relativism, than from any broad acquaintance with the growing body of literature on the subject. This would seem one area where more attention needs to be paid to technology in teacher education.

Cautious or often negative attitudes towards mass media frequently colour attitudes towards the use of instructional media. Such an approach is analogous to equating Harlequin romances with textbooks. Perhaps because it is so difficult to interpret and understand the ideas, emotions, images, and symbols conveyed in print, that trying to understand the somewhat different ideas, emotions, images, and symbols conveyed by visual media seem to educators to require an investment of effort they are not prepared to make.

Learning from images, however, is a critical part of the processes which touch on technology in education. Dale's (1954) idea of using visual media to provide vicarious experiences for learners seems to be worth resurrecting in today's world, where the materials with which students are allowed to work in subjects like science are curtailed by safety and cost concerns. In subjects such as social studies and language arts, visits to many locations in Canada and the world may be made easily via visual media, and these visits may include microcosmic and macrocosmic views. Such enhancements to learning are as useful today as they were when the arguments for them were developed three and four decades ago as a part of the audiovisual education movement.

The accumulation of decades of research in this area is supportive, but only in a tepid fashion. This can be attributed to years of studies yielding "no significant difference" results, studies which have compared the delivery of instruction by a teacher to the presentation of the same information by technological means, with a written test at the end. Such studies tended not to be described as focusing on the communication by images versus the communications by oral and print means, but as focusing on the communication by teacher versus the communication by film projector, or some other medium. Such studies were intended, in many cases, to provide practical support for the introduction of the innovative technologies of the day, rather than attempting to illuminate they ways in which students learned. They gave rise to ongoing, sometime vituperative debates on the replacement of teachers by film projectors, or teaching machines, or television sets, or whatever the bandwagon innovation of the day, the new saviour of education, was perceived to be. For example, Clark (1983) and Clark and Sugrue (1988) have provided some very illuminating analysis of the shortcomings of this approach to research in media and technology. It is important to remember that, for all their flaws, these studies repeatedly showed no significant differences in learning, even though the evaluation instruments were consistently biased toward print and verbal communications.

It is interesting to reflect on approaches to evaluating learning from images which could truly take into account the levels of understanding we derive from seeing, through visual media, a stream of glowing orange lava flowing over and consuming the organic material, while streams of volcanic ash darken the sky and people and animals flee from its path. Somehow, questions such as, what is the temperature of molten rock?, and what causes a volcano to erupt?, do not seem to explore the real dimensions of human response to such a phenomenon.

The role of computers in education is another vital area of interest with regard to technology and teacher education. Should teacher education programs be emphasizing the use of computers for professional productivity tasks involving word processors, spreadsheets, and other software, as many university courses for teachers currently do? Should they be emphasizing the use of computers as tools for problem solving and information retrieval as others advocate? Or should they be emphasizing teaching with computers, showing teachers in training how pupils can use the newer generations of powerful computer based learning programs to learn many concepts and skills more quickly and take control of their own learning? It would be exciting to see lively, informed debate on these questions throughout the broad educational community. Such debate might help us provide better answers and stronger elements of teacher training programs with regard to computers.

As previously mentioned, the gathering of support for the implementation of new technologies has been an important element of applied research for several decades. It might be surmised that this derives from the cost of technology and the cost of learning resources. Several generations of audio-visual specialists, librarians, learning resource directors, and instructional technologists working within schools have speculated on why it has been so difficult to obtain support for the provision of learning resources. This question persists as we continue to insist that the way to educate self-fulfilled, motivated human beings who can work and participate in a society which is increasingly technologically based and information reliant, is to have them talk to the decreasingly self-fulfilled, increasingly stressed human beings we call teachers.

What then is in this issue to explore issues related to technology and teacher education?

There is a noteworthy difference between educators interested in technology and the subset who describe themselves as educational or instructional technologists. Educational technologists are adherents to the idea that learners will learn more and become more independent and self-motivated if there is a focus on learning, rather than teaching. They see such a focus involving overt planning for or guiding of learners, and developing and implementing environments for learning which address those plans or guiding structures, employing some stated form of evaluation. The first two of the papers in this issue contribute to the discussion of educational/instructional technology and how it might relate to tomorrow's schools.

The first article raises the need for change within the public school system and what educational technologists might contribute to the process of change. Richard Kenny begins by arguing that there is a need for change and improvement in the public school system and that educational technologists can contribute significantly to the process. He explores that contribution with regard to three approaches to improving the public schools noted by Salisbury (1987). The three approaches were: school system reorganization; the teacher-training approach; and the diffusion/adoption approach derived from strategies of planned change.

In the second article Jim LaFollette examines the limited impact which communications and information technologies, and the more encompassing instructional technology, have had on schools. His discussion proceeds with reference to three metaphors for the application of technology; a tools metaphor, a systems technology metaphor; and a "systemic, gestaltic, and aesthetic metaphor". In concluding his arguments he uses the cyclical nature of the patterns of technological innovation and the rhetoric surrounding them to remind us, to paraphrase Eliot, that time present and time past need to be both perhaps present in time future. There have been many viable solutions demonstrated in the past, but their general acceptance on a large scale still has not occurred. The "challenge", as LaFollette puts it, is still with us.

Embedded in both the Kenny and LaFollette papers are numerous questions about the best ways to involve teachers in thinking about using technology in education. They are important questions in both the in-service and pre-service dimensions of teacher education.

Distance education is another of the topics which has become symbiotically linked with technology in education in the past two decades. Successful distance education may be seen to have a need for both instructional design techniques and an understanding of the communications and information technologies which maybe employed in it. Margaret Haughey examines these elements and the aspects of learners and teaching approaches which must be taken into account to create a successful distance education experience. She also outlines the implications such elements have for teacher education. These implications seem clear and straightforward. They are also very similar to suggestions made by other authors for helping beginning teachers increase the number of learning alternatives they can present to their students in conventional classrooms, and obtain the skills in using technology those beginning teachers need.

An important shift in instructional technology has been the movement away from a paradigm based in systematic design techniques and behavioral psychology to an exploration of other ways of designing instruction which involve different epistemological bases. While many of these have involved moves to cognitive psychology and the constructivist paradigms (Duffy & Jonassen, 1991; Jonassen, 1991), and others have explored "illuminative, semiotic and post-modern modes of inquiry" (Hylnka & Belland, 1991), there are other dimensions of developing instruction, particularly complex instruction for newer media. Katy Campbell-Bonar and Alton Olson have contributed to this special issue with a discussion of how elements of culture-building may be seen to influence the building of an instructional-design team environment for multimedia projects which makes maximum use of the knowledge and skills of all team members.

Finally, with the impact that computer technology has had on education in the past decade, and with reference to the fiftieth anniversary of the Faculty of Education, it seems fitting to end with a retrospective on the development of computing, and in particular CAI, in the Faculty of Education at the University of Alberta. The perspective of Steve Hunka and George Buck on these events might be challenged by others but the article is significant in that it paints the progress of one Faculty against the larger background canvas of educational computing in North America. There also remains the task of a companion piece which should be written to chronicle other audiovisual developments in the Faculty of Education, in particular the pioneering work done in the mid-sixties with educational television by Dr. John Fritz, Dr. Wayne Dralle, John Philpot, and other Faculty members.

CONCLUSION

Technology and teacher education remain unreconciled. Obtaining agreement on whether reconciliation might be achieved through evolution or revolution remains largely unknowable from previous experience, but the consideration needs to take place in a larger arena. Talking amongst ourselves is not enough. It is time to enter more vigorously into discussions with curriculum people, school reformers, educational philosophers, administrators, and others, and these discussions need to be undertaken in their forums. It seems vital to have the ideas surrounding the use of technology in education brought more into the forefront as ideas about school improvement are debated in some quarters, and the approach to more complete self-fulfilment for students is debated in others. Some provincial Departments of Education have been developing ideas of how technology and education may be brought closer together, and these ideas also need to be analyzed and considered at greater length as part of the proposed dialogue. A better understanding of what tomorrow's teachers should be learning in their teacher education programs should come from this. We know that the technologies will not remain static. As lower cost, higher volume computer memory becomes available; as markedly improved video compression algorithms move to market; and as our standards for moving very large volumes of data from point to point improve; the technologies which influence our lives will be even more ubiquitous, and provide even more possibilities for educators. Will we be prepared and able to deal with technology, to provide the kind of learning environments for students that will make the best use of all of the human and non-human resources we have? Or not!

The development of this issue made extensive use of both the *CJEC* editorial board and colleagues at the University of Alberta who provided their perspectives on the manuscripts offered for inclusion in this fiftieth anniversary issue. The editor would like to thank the following people at the University of Alberta for the advice and assistance they so willingly gave: Charles Bidwell; Katy Campbell-Bonar; Douglas J. Engel; Margaret Haughey; Grace Malicky; and Gene Romaniuk.

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GUEST EDITOR

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Can Educational Technologists Help Change Public School Education?

Richard F. Kenny

Abstract: During the past decade, public schools have been subject to demands - particularly In the U.S. - that they be changed, even restructured. While educational technologists have joined in the debate, they have not tended to participate at this level. This paper first examines the question of whether Canadians see a need for change in their public schools. It next reviews what educational technologists might offer to the change process. Finally, three different strategies are suggested to help educational technologists improve K-l 2 education. These are (a) participate In total restructuring efforts, (b) train in-school personnel as educational technologists and (c) act as external change agents to improve teaching-with-technology and to develop innovative computer-based learning materials and environments. It is concluded that the third approach is that likely to be the most feasible and productive under current conditions.

Resume: Au cours des dix dernieres annees, les ecoles publiques, partlculierement celles des Etats-Unls, ont ete pressees de changer et de se restructurer. Les technologues p6dagogiques etaient de la discussion mais ils n'etaient pas de la partie a d'autres niveaux, Get expose exam ine done ce que pensent les Canadlens de la necessite d'apporter des changements aux ecoles publiques? Le role que peuvent jouer les technologues pedagogiques est aussi abordee et trois strategies sont suggerees aux technologues pedagogiques pour ameliorer le systeme d'educatlon K-l 2 : (a) la participation active des technologues pedagogique 6 la restructuratlon totale du systeme; (b) la formation en technologies pedagogiques du personnel enseignant deja en place; (c) et l'adoption par les technologues pedagogiques du r6le d'agent pour l'amelioration de l'enselgnement asslste par ordlnateuret, pourundeveloppementinnovateurd'envlronnementsetdeproduits d'apprentissage assistes par ordinateur. Nous sommes d'avis que la troisleme approche est probablement la plus appropriee et la plus productive dans les conditions actuelles.

INTRODUCTION

The need for change in public school education has been a topic of much discussion during the past decade in the United States, and to a lesser degree, in Canada. American reports and books indicating that the quality of instruction must improve have abounded (e.g., Boyer, 1983; Goodlad, 1983; National Commission on Excellence in Education, 1983). The overt, sometimes strident,

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tone of the debate, however, may reflect the relatively large involvement of the American federal government in education as well as perceptions of the competitive position of American society in the world order.

The Canadian Viewpoint

Canadians appear to be less concerned about the state of their educational system. Maguire (1986) indicates several reasons: education is strongly entrenched as a provincial responsibility, there is a tradition of a conservative, non-interventionist supreme court and the time lag between the creation of ideas in the U. S. and their movement to Canada leaves space to evaluate and pick the best. Indeed, Canadians appear generally satisfied with their schools. Lee (1988) found that, in Manitoba, 48% of the public gave elementary schools a "B", while 41% awarded high schools a "C". An Ontario study (Livingstone, Hart, & Davie, 1990) found that nearly half (47%) of those surveyed were satisfied with the "current situation" in Ontario elementary and high schools while less than one third (29%) were dissatisfied. A Canadian Education Association sponsored Gallup poll (1984) found respondents more confident in Canadian schools than in other institutions, while a more recent CEA poll (Williams & Millinoff, 1990) found that most Canadians gave the schools in their community a B (39%) or a C (35%). The authors concluded that this suggests a relatively high degree of satisfaction with the schools. While positive, "B" and "C" scores are not "A's". As well, Ontarians are concerned with certain aspects of school performance, with the core curriculum and the link between schooling and jobs (Livingstone & Hart, 1987). On the other hand, they do not confuse such issues with the larger economic and social problems created outside the schools, but look to the schools to aid in their resolution. Overall, it appears that Canadians think their schools can improve, but should they?

Why Schools Should be Improved

Fullan (1982) stresses that educational changes are not ends in themselves but must be considered in relation to the basic purposes and outcomes of schools. Innovations should be introduced to help schools accomplish their goals more effectively by replacing some programs or practices with better ones. In his view, schools serve to educate students in the academic and social skills and knowledge necessary to function occupationally and sociopolitically in society.

Yet, modern society has not remained static, nor have the academic and social skills required of its citizens. A current example of this is the technological impact of computers and the rapid development of the information society. Schools, though, have been slow to adapt (Dalton, 1989). Successful examples of computer use in classroom practice are still relatively rare (van den Akker, Keursten, & Plomp, in press). And yet, technology will continue to shape our processes and systems of schooling and will have an important role to play in the future of education (DiSessa, 1987; Foster, 1988). Even in the absence of overt demands, there is pressure for change.

Moreover, Fullan indicates several reasons, based on research, why school reform is necessary:

- Many innovative teaching practices of the new curricula of the 1960's and 1970's have not been implemented despite their endorsement in national, regional and local policy statements.
- There is an almost arbitrary variation and emphasis in classrooms on some subjects over others with many teachers teaching in subject areas for which they have limited preparation.
- Teachers do not have time for reflection or analysis either individually or collectively about what they are doing.
- There is every reason to believe that the textbook industry dominates the teachers' field of choice in many states in the U.S. and several provinces in Canada.
- Change is needed because many teachers are frustrated, bored and alienated.
- Most teachers do not take the initiative to promote changes beyond their classroom because of their cultural conditions and practicality concerns (1982, pp. 116-120).

And finally, Fullan, Bennett and Rolheiser-Bennett (1990) have indicated that more is now known about effective schools. Educators have learned a great deal about classroom and school improvement recently and are able to make more informed decisions. From a number of points of view, then, public school education can, and should, change. It remains to be decided what form such change should take and who should implement it.

The Practice of Educational Technology

If schools should change, who will do it? What skills do educational technologists offer to the process? The colloquial use of "technology" connotes devices and related materials — especially computer hardware and software. However, it is technology as applied science that was meant by those who adopted the term "educational technology". *Instructional technology* has been recently defined as "a discipline concerned with the systematic design, development, evaluation, and management of instruction and instructional materials" (Branch, 1990, p.6). Educational technology has been variously viewed as either including, or a subset of, instructional technology (c.f. AECT, 1977, p.3).

The Systems Approach

Regardless, the field is most often associated with the systems approach to the design and development of instruction. This includes such techniques as needs assessment, articulating behaviourally stated objectives, using objectives to determine strategies/media and evaluation criteria, and carrying out some form of assessment of the product or service (Rossett, 1987). Assessment of student performance should be examined in light of the developed objectives to determine whether instruction should be revised and whether learners require remediation (Dick & Reiser, 1989, as cited in Reiser & Mory, 1991). An educational technologist would be someone proficient in this approach.

For some, the systems approach is sufficient. Heinich (1984), for instance, claims that instructional technology allows all instructional contingencies to be managed through time and space. The application of the systems approach permits the development of reliable and replicable instruction. However, the argument that educational technologists know enough about instruction and, particularly, the role of media, to effectively direct and manage learning is in dispute. Clark and Sugrue (1988) conclude that media do not directly influence learning. Further research is needed to determine the necessary conditions for learning.

The Cognitivist Paradigm

In fact, the research focus in the field of educational technology in recent years has been characterized by a shift towards understanding the learning process and to a greater adherence to cognitive theoretical orientations (Bernard & Lundgren-Cayrol, 1991). Many writers now consider the systems approach to reflect a dated paradigm - behavioural psychology. Nunan (1983) insists that the emphasis of the systems approach on behavioural objectives results in a focus on discrete, overt behavior. It takes control out of the hands of teachers and conflicts with the creative and adaptive nature of teaching. The cognitivist view is that learners actively process the information presented to them and construct their own meaning from instruction (Winn, 1989). Winn argues for the use of first principles of learning. Educational technology will only advance when "students of instructional design are taught to reason about the consequences of instructional strategies for learning and not just to follow prescribed steps in a design model" (p. 43).

Those advocating cognitive constructivism go further. From this perspective, learning is not the process of mapping the real world into the mind of the learner. Rather, how one constructs knowledge is a function of the prior experiences, mental structures, and beliefs that one uses to interpret objects and events (Jonassen, 1991). That one can specify in advance what a learner might or might not learn, then, is debatable. The capability of the systems approach to produce reliable and replicable instruction is thrown into question.

Resolving Conflicting Viewpoints

Given these varying views of the practice of the educational technology, can its proponents offer anything to public school education? Rossett (1987) stresses that there is a body of research and theory to apply. It is a question of which theories and how well they are applied. Reigeluth (1989) believes that the uncertainty indicates that the field of educational technology is at a synthesis stage. There is, in his view, "a considerable knowledge base of validated prescriptions, [albeit] primarily for the simpler types of learning." Practitioners now need to think holistically and concentrate on "building components into optimal models of instruction for different situations" (Beigeluth, 1989, p.70).

These conflicting viewpoints may reflect a healthy field which remains open to debate and can adapt to new paradigms, that is, change itself. How its practitioners can effect (or affect) change in the public school system will depend on which view of the field they hold, the circumstances under which they become involved and the role they choose to play.

THE ROLE OF THE EDUCATIONAL TECHNOLOGIST IN PUBLIC SCHOOL EDUCATION CHANGE

Given that change is both needed and possible in public school education, what role can educational technologists play in the process? Salisbury (1987) notes three distinct approaches to improving public schools: school system reorganization, the teacher-training approach and the diffusion/adoption approach.

Change the System

Many writers argue that public schools are outmoded. Long-lasting change will only occur if school systems are radically re-organized or restructured. Views of how to do this, however, vary widely (Heinich, 1984; Reigeluth, 1987, 1991; Branson, 1987; Peck, 1991; Banathy, 1991).

Use the systems approach. Heinich (1984) claims that the application of educational technology (i.e., the systems approach) can result in superior instruction in schools. In his view, "the basic premise of instructional technology is that all instructional contingencies can be managed through space and time... Primary emphasis is given to the development of more powerful technologies along with the development of organizational structures that facilitate their use" (p. 68). Such organizational structures would place subprofessionals (aides) in the most frequent contact with students and reserve professional contact for specific instructionally oriented purposes. Educational technologists would create change in public education by creating large scale mediated instructional systems to replace the current system.

Branson (1987) attributes declines in school performance and quality to an obsolete management model, improvements to which "have reached their practical upper limit; that is, performing in the vicinity of 97% to 98% as well as they can ever function *according to the current design philosophy* [original emphasis]" (p. 16). This archaic classroom concept should be abandoned in favour of a school environment that is designed for function; that is, both individual learning and group processes. Branson advocates the use of the systems approach but in conjunction with change models, improved management models and other approaches for improving instruction. Educational technology has a role but is not the sole player.

Use systems design. Banathy (1991) states that public schools represent the design of an earlier (industrial) society. Previous reform efforts have failed because they "have not grappled with the essential nature of education as a societal system", one which is "embedded in the rapidly and dynamically changing larger society" (Banathy, 1991, p. 12). The solution, he claims, lies not with the systems *approach* advocated by educational technologists, but in the use of systems *design.* Banathy's systems design consists of four spirals of activity: a) the creation of an image of a future educational system, b) the development of a core definition and system specifications, c) the description of system functions, and d) the design of systems and organizations to manage and carry out the specified functions. Banathy offers a specific methodology for restructuring schools but defers the particular design to the individual community.

Other writers suggest specific designs. Reigeluth (1987, 1991) calls for the development of a third wave educational system. Piecemeal modifications of the present system will not work and system-wide planning and modification is required. Reigeluth offers a blueprint for a cluster system operating on an entrepreneurial basis. Teachers, working cooperatively within clusters, would serve as guides to help each child meet individual goals. Much of the instruction would be provided by independent learning labs to which the clusters would have access. Like Branson, Reigeluth views educational technology in a service, not commanding, role.

The approach of Project Rethink (Peck, 1991) is a cooperative effort between the Pennsylvania State University and a local school district to reinvent middle school (junior high) education. Standard subjects and the traditional school day are being replaced with four activity strands: a) multidisciplinary projects, b) creativity, problem-solving and thinking skills, c) independent study, and d) basic knowledge and skills offered via computer-based instruction (CBI). The CBI is being developed by a team of instructional designers from the university. Other schools and school districts interested in the project will be supplied with a series of steps to follow, a list of materials and equipment to acquire and a pre-designed set of learning materials.

Restructuring and the change process. Which, if any, of these positions is feasible? Although Heinich insists that educational technology provides a clear alternative, his position on the capabilities of the field is in dispute (e.g., Clark & Sugrue, 1988; Kerr, 1989). Nor does he take change theory into account. His approach demands fidelity of implementation or what Berman (1981) termed a *technologically dominant process.* Berman, however, notes that "the interaction between an educational technology and its setting can be uncertain because of the technology's characteristics or how it is used" (p. 262). How an innovation is implemented may be as important to outcomes as its initial technology. Reigeluth and Peck have addressed implementation, although only Branson specifically discusses change models. Banathy's systems design is a form of change model but is quite extensive in scope. Also, the question of who would implement this approach is problematic, for as Banathy (1991, p. 154) notes, "neither schools of education nor educational professional development programs offer curricula in systems design".

Regardless, while demonstration projects such as that developed by Peck (1991) may be successfully implemented in one or two schools and even draw acclaim, such restructuring efforts are not likely to become widespread. The pressure for large scale changes is not likely to bear fruit because of the diversity created [in the U.S.] by state and local control of education and because "that control is rooted in the United States Constitution by the strongest kind of political support" (Burkman, 1987, p.31). That argument holds true in Canada as well. Further, considerable research (Berman, 1981; Fullan, 1982) has indicated the difficulty of implementing and institutionalizing even small scale change.

Teach the Teachers

Teach the systems approach. Some propose to train teachers to use the systems approach to improve instruction (e.g., Snelbecker, 1987; Klein, 1991; Earle, 1992). Snelbecker (1987) advocates that teachers be taught instructional design skills both in preset-vice and inservice education. He contends that teachers "need at least fundamental instructional design strategies to plan, evaluate and modify instruction as a regular and continuing part of their classroom duties" (p. 35). He offers several suggestions for addressing "technology transfer" problems, including providing assistance to teachers in recognizing how instructional design techniques can be made relevant for their day-to-day activities, assistance for integrating content and method and assistance in recognizing how some aspects of a theory may be adopted or adapted for their setting. Further, Snelbecker postulates that contemporary uses of microcomputers in education might lead to increased interest in instructional design skills and provide a window of opportunity.

Earle (1992) concurs, stating that it is the school system that requires attention and that this can be improved by means of systematic design of instruction. He provides evidence that courses in instructional design can be successfully incorporated into the undergraduate teacher education program. Further, teachers thus trained report that a knowledge of systematic design processes has improved their planning (Earle, 1992). A study by Klein (1991)also demonstrated that preservice teachers were successful in acquiring and using principles of learning and instructional design. Reiser and Mora (1991) compared the planning of an experienced teacher trained in systematic design to another not trained. They concluded that teachers who have received formal training in the use of a systematic planning model are likely to employ it. The assumption here is that the application of the systems approach by teachers will lead to improved instructional planning and practice. However, some research evidence indicates that this may not be the case. Reiser and Mora (1991) also found that teachers not trained in the systems approach still plan their instructional activities with their objectives clearly in mind. Further, trained or not, teachers work mainly from mental plans and their planning processes are quite similar. Only in the area of student assessment is the difference striking. A teacher trained in the systematic design used far more written tests to verify achievement of unit objectives while one not trained in the process relied on informal observation. Moreover, according to Branch, Darwazeh, and El-Hindi (1992), the argument for training in the systems approach is fallacious because teachers already engage in instructional design practice. Their study revealed a positive correlation between teacher planning activities and instructional design practices. The problem, they suggest, is that instructional design jargon inhibits communication between educational technologists and teachers.

Engage in staff development. Shrock and Byrd (1987) suggest that educational technologists would "find it instructive to examine the messages that are currently being delivered to teachers through staff development [because it] is one of the most influential forces currently impinging on teacher behavior" (p.45). They argue that the instructional design model has much in common with both the effective teaching message and the reflective teaching message, but offers a more comprehensive schema. Educational technologists should enter the debate taking place within the field of staff development. As well, like Snelbecker and Earle, they advise educational technologists to become involved in preservice teacher education in order to provide teachers with a "frame of reference to put instructional research findings into perspective and to apply the results conditionally" (p.52).

Train the school media specialist. Schiffman (1987) suggests that educational technologists train school media specialists as internal change agents. It is her view that "technological developments and the growing interest in information literacy have brought school library media centers to prominence among educators" [and that] "the computerization of library systems is also finally making it possible for school library media specialists to devote a portion of their time to instructional matters" (p.41). Schiffman notes that more than a third of all graduates of educational technology programs take positions in school library media centers but tend to come from programs that emphasize "media" rather than "instructional systems design". She argues that these school library media specialists be trained in instructional design theory and the use of computer and information technologies. Thus armed, they would be well equipped to act as in-house change agents by providing design and production advice to teachers.

Teaching teachers and the change process. Such indirect approaches are more likely to succeed than the advocacy of wholesale change to the public school system. Rather than an implementation dominant process, they represent what Berman (1981) terms *mutual adaptation;* that is, both the innovation and the organization adapt. Berman suggests that effectively implemented innovations are characterized by this process. As well, by considering teacher practice, they are also indicating the appropriateness of the innovation, an important step according to Fullan (1982). When the innovation is a completely restructured school or school system, it is doubtful that mutual adaptation occurs —even when teachers are involved in the change, as was the case in Project Rethink (Peck, 1991). Complete restructuring is necessarily implementation dominant.

However, it is not clear that any of the proposals to convert teachers into educational technologists takes into account all three dimensions that Fullan considers necessary to achieve change. They address the possible use of new teaching approaches and the possible alteration of beliefs, but not the provision of new or revised materials. It is presumed that teachers, or school library media specialists, will use the newly acquired skills to develop their own. These proposals fall one step short. Even educational technology graduates often find it difficult to make full use of the systems approach in the field (Eossett, 1987; Lange & Gravdahl, 1989).

Take a Diffusion IAdoption Perspective

Some educational technologists believe that members of the field can be effective *external* change agents. They stress the application of change theory in effecting reorganization in public school education.

Work at the system level. Despite the more recent evidence (Earle, 1992; Branch, Darwazeh, & El-Hindi, 1992) to the contrary, Burkman (1987) insists that current school practice does not even meet the minimal requirements for systems design. Goals often remain tacit and objectives left unstated, let alone written in behavioral form. In his view, the most realistic way to get instructional systems design utilized in the classroom is to work to reduce the complexity of the existing system. He advocates focusing at the local school system level, developing projects which concentrate on a single subject and focus on subjects which are skill oriented and easy to attack with the techniques of educational technology.

Work directly with teachers. Dalton (1989) asserts that educational technologists make ideal change agents. The systems approach allows them to determine if a change is needed, analyze the environment, evaluate the consequences of their actions and decide on courses of action based on the best evidence available. Dalton advocates that educational technologists examine their solutions in light of the wants of the implementors and offers several suggestions. The majority involve creating instructional materials and working with teachers directly to effect change. Dalton suggests: a) building cooperative computer-based learning environments and friendlier computer interfaces, b) developing software integrated with routine curriculum objectives, c) providing teacher training in the use of the particular innovation, d) letting the teacher make the decision about the use of computer technologies and/or e) defining new roles for the teacher as counsellor, developer and manager.

Kerr (1989) concurs with Dalton. He rejects the views of Heinich and others who would strictly apply the systems approach for ignoring schools as social institutions and focusing narrowly on the transmission of information. Educational technologists should work with school reform communities on: a) the preparation of models of teaching-with-technology, b) the design of software, c) the creation of computer-based tools to support teachers' professional development, and d) the improvement of research on teaching-with-technology. Mappin and Campbell-Bonar (1990) provide an example with their approach to the development and implementation of interactive video. They stressed building client involvement and presenting alternative approaches to instruction and theory at different points in the process. They identified seven selected points of intervention:

- analyzing the audience, keeping both the instructors and students in mind;
- identifying educational and training needs;
- stating detailed learning objectives in terms of "plausible" responses to classroom situations;
- selecting media appropriate to instructor needs;
- key decision makers accepting the final design;
- (the production phase) working with a core design team with the provision to allow key decision makers to review work at specific points;
- (the implementation phase) introducing the final product, [and providing] inservice sessions for instructors at the beginning of the term, supporting materials, a utilization consultant and on-going equipment and technical support (pp. 8-11).

Emphasizing the importance of implementation led to a model which helped ensure that process but also led to materials more directly tied to perceived problems.

CONCLUSION

It is the view of this writer that the diffusion/adoption approach offers educational technologists the best route to generating change in the public schools. It takes full advantage of their expertise by allowing them to apply their instructional design skills to the improvement of instruction and also takes into account Fullan's (1982) three dimensions of change. In fact, Dalton (1989) and Kerr (1989) have independently suggested many of the criteria advanced by Fullan, Miles, and Anderson (1988) as necessary for an effective strategy for implementing microcomputers such as local responsiveness, initial acceptance of an uncertain target, provision for increasing target clarity and intense, sustained, responsive assistance.

Educational technologists must maintain a realistic view of what their design techniques can achieve and continue to improve them in light of developing theory and technology. That, coupled with a sound knowledge of change as a process and a willingness to accept the role of external change agent working in cooperation with teachers, administrators and other educators, could make them valuable indeed in initiating needed change in public school education.

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Instructional Technology and Teacher Education

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Abstract: In spite of Increased availability of technologies In the schools, their Im pact on instruction has been quite limited. Teacher education programs contribute to what happens In schools, and both levels of the educational system have been criticized for maintaining traditional patterns which are Inconsistent with what Is happening in the greater society. Several causes of the failure of schools to effectively utilize available technologies have been advanced, Including thefallure of teacher education programs to adequately prepare teachers to use technologies effectively. Potential solutions have been offered, although strategies for bringing thesolutlonstofulfillment are lacking. Most of the solutionssuggest adoption of an holistic process of instructional technology, reflecting three metaphors: tools, systematic, and systemic, in order to effect appropriate integration of available technologies and the curriculum.

Resume: Malgre la presence grandissante des nouvelles technologies dans les ecoles, rim pact de celles-ci sur la formation a jusqu'd present ete plut&t Ilmite. Les programmes de formation pedagogique y sont pour quelque chose. Les deux niveaux du systeme pedagogique ont ete mis en cause parce qu'ils malntiennent les modeles tradltlonnels en place alors que ceux-cl ne correspondent plus d ce qul se passe dans la societe en general.

Plusleurs ralsons peuvent expllquer pourquoi les ecoles utilisent mal les technologies disponlbles. Les programmes de formation pedagogique qui ne preparent pas convenablement les enselgnants sont en partle responsable de cette etat de chose. Certalnes solutions ont et6 proposees mals sans strategie d'appllcatlon. La plupart des solutions suggerent ('adoption d'un processus de formation technique global a trols volets : les outlls, la methode et le systeme - elements essentlels d l'integration des technologies disponibles au programmes d'etudes.

We live in a technological world. Our daily actions and thoughts are interwoven with the technologies with which we come into contact. Technologies are not neutral and neither are people. We are influenced by technologies, but we in turn have the power to regulate what they do to us.

There is much uncertainty over the meaning *of technology.* When the term is accompanied by an antecedent such as *instructional,* the meaning becomes even less clear. Instructional technology, as it is addressed here, refers to a

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process involving appropriate techniques to bring about effective instruction in order to facilitate desired learning outcomes. All the people and/or machines involved in the process are a part of it. Instructional technology as a process is not inherently narrow and mechanistic. In fact it has been suggested that the broader, but closely related construct, educational technology evokes three constantly shifting metaphors (Davies, 1973; Hlynka & Nelson, 1985). The three metaphors are related to implicit structures which help to define the nature of educational technology: "At one point, teachers as technologists function within the tools metaphor. At another time the same teachers may function systematically while, at a third point, the systemic, gestaltic, and aesthetic metaphor gains control" (Hlynka & Nelson, 1985, p. 13).

Instructional technology is often inappropriately considered to represent only the tools metaphor. In fact, instructional technology is sometimes equated only with using computers for instruction. However, microcomputers and their related courseware, as well as the many technologies which facilitate learning by providing a wealth of pictorial material would be best described as technologies for instruction.

The systematic metaphor is associated with contemporary practices in the field of instructional design. A product of the industrial machine age, and closely related to systems engineering, the instructional systems design model has been criticized for its emphasis on fixed objectives and for being a deterministic, closed system. Still, it represents a flexible framework which is capable of accommodating a variety of learning theories in decision-oriented instructional contexts (Dick, 1991).

A systemic, holistic view of educational technology, which is less mechanistic, and more humanistic, emancipatory, and organic has only recently begun to evolve. Although not fully clarified at the moment, the construct is rapidly gaining momentum (Balaban, 1990; Melton, 1990; Nichols, 1990). Banathy (1987, 1991) has proposed a broad "macro-systemic" orientation, the purpose of which is to view school settings as complex, open, and dynamic systems that are in constant interaction with their environment (the societal system).

If we agree that technology's role in education has not been totally defined nor widely accepted by educators, why consider using technologies in education in the first place? Although the residue of over 50 years of research would seem to be conclusive at first glance, considerable skepticism has been advanced relative to whether the technologies (media) used for instructional delivery actually make a difference (Clark, 1983; Clark & Salomon, 1987; Clark & Sugrue, 1988). The argument that any medium is equally effective when the instruction presented is equivalent across media is difficult to reject, but is not just cause for suggesting that technologies are not required in education. Other conclusions may be derived from the research, most notably the persistent finding that where significant outcomes favored a technological delivery system, highly effective planning took place.

The expansion of technology in education during slightly more than a decade has been described as "rapid and chaotic" (AACTE Task Force on Technology, 1987, p. 25), with "unprecedented growth in the amount of technology available in schools" (Glenn & Carrier, 1989, p. 7). Still, a major government report in the United States, while documenting and projecting the number of microcomputers in the schools to well over 2,000,000, concludes that "few teachers have found ways to exploit the enormous potential which interactive technologies offer" (United States Congress Office of Technology Assessment, 1988, p. 87).

Public schools are constantly being asked to respond to a growing list of society's needs and concerns. At the same time critics are calling for more quality and more rigor for all students (Glenn & Carrier, 1989). Further, the critics point out that schools have failed to keep up with the times:

> Inside and out, schools today look very much the way they did a hundred years ago: the buildings, the size and shape of classrooms, the divisions based on age, and the ways of "delivering" instruction have changed very little. Yet the world has changed remarkably. Families, jobs, social organizations, and entertainment look nothing like they did at the turn of the century. From inside a school, however, one would hardly know that visual images, rapid motion, technology, and change are pervasive in the world outside. (David, 1991, p. 37)

We are constantly aware of the rapid influx of technology and we recognize that significant change is taking place in society. We speak of change, but what really is new? A statement first published nearly 40 years ago suggests: "What is new is that in one generation our knowledge of the natural world engulfs, upsets, and complements all knowledge of the natural world before" (Oppenheimer, in Bennis, Benne, Chin, & Corey, 1976, p. 1). Thus our mission is to recognize the change, learn what resources we have, and try to use the available resources in appropriate ways.

"FAILURE" OF SCHOOLS TO EFFECTIVELY USE TECHNOLOGIES

Why have schools failed to take optimal advantage of technologies for instruction? What's wrong? What factors have contributed to this apparent failure? There is a lack of universal agreement, and some of the causes which are advanced below may tend to contradict others. It must also be noted that a "tools" metaphor tends to dominate in the following summary of viewpoints which have recently been advanced in North America:

- Schools are purchasing more hardware, but the impact on classroom instruction is at best negligible. Computers remain a neglected resource within our schools (Futrell, 1989). The vast majority of schools still do not have sufficient numbers of computers to make them an integral part of the instructional process (Glenn & Carrier, 1989).

- It has been claimed that the vast majority of teachers have little or no training in the use of technology (Glenn & Carrier, 1989). Even when new teachers have been taught to use computers, they usually have not been taught how to *teach* with computers (Futrell, 1989).
- If a technology (the computer) plays no role in academic courses, it is unlikely to have much total effect on the educational system. When the question of what technology should be used is driven by the latest piece of equipment, rather than by pedagogical considerations, there is a complete lack of curriculum and learning consideration. "Decisions made without taking into account the full learning context are likely not to be adequate decisions" (Bork, 1991, p. 362).
- School leaders often lack understanding of the products and processes of instructional technology. Thus, they have difficulty in providing support to teachers and staff which can assure the desirable use of technologies in their schools (Bitter & Yohe, 1989).
- The computer literacy movement, with its emphasis on programming resulted in many years of relatively wasted effort (Marker & Ehman, 1989). Research has demonstrated that programming does not increase problem solving capabilities. Teaching programming represents limited use of the computer in education, and student time might better be devoted to other purposes (Bork, 1991).
- While many teacher education programs and school districts have inservice programs on effective instructional strategies and using technology, seldom do they bring them together (Futrell, 1989). In particular, beginning teachers are bitter because of the lack of connection between what aspiring teachers are exposed to through teacher preparation curricula and what they encounter in their classrooms (Glenn & Carrier, 1989).
- An erroneous assumption is that the computer is an entity in and of itself, and thus deserves a special "laboratory," a special curriculum, and a special teacher to teach it. What might have initially been a well intended idea, albeit ill-founded, has become a roadblock to change (Salomon, 1990).

The same criticism might well be extended to include the sanctification of the classroom "box" model of instruction in the schools.

Finally, an aspect of the problem seems to be that we seldom make effective use of the "tool" technologies that we have. We seem all too eager to proceed to newer delivery systems, even when we have had limited success with available technologies. This is obviously the case with schools and teacher education programs alike, and the two are closely linked, even though the level of collaborative effort is frequently low. Since teacher education programs are responsible for preparing the present and future complement of teachers, we now examine factors in those programs which may have contributed to the failure of schools to use all available resources in the most appropriate manner.

TEACHER EDUCATION PROGRAMS AND THEIR CONTRIBUTION TO 'TAILURE"

There is widespread agreement that if schools are to use new and emerging technologies to improve the quality of schooling, teacher education programs will need to make a major contribution (AACTE Task Force on Technology, 1987; Bitter & Yohe, 1989; Futrell, 1989; Cooler, 1989; Harrington, 1991; OTA, 1988). Teacher education programs must be considered an integral component of the entire societal landscape. We now focus on teacher education programs and their influence, drawing primarily on recent North American perspectives of the situation.

As long as the university remains the primary gatekeeper for preparing new teachers, the content of preparation programs for teachers will largely be determined, for better or worse, by professors who teach teachers. However, many teacher educators are not prepared to use technology effectively in their courses (this includes older technologies as well as emerging interactive technologies). The bulk of faculty currently engaged in teacher preparation were themselves not prepared to use technologies, nor have most kept current with technological developments. Unfortunately, structural issues such as how things should be taught, by whom, on who's turf, etc., represent potential barriers to effective teaching about technologies for instruction in teacher education programs (Cooler, 1989).

Teacher education programs continue to suffer from "congenital prestige deprivation" and their fundamental structure remains largely unchanged, as many "programs remain wed to entrenched orthodoxies and mired in an organizational time warp" (Futrell, 1989, p. 45).

Such obsolete programs present an increasing problem for teacher educators as they struggle to keep pace with changes taking place in the public schools. Few models of instruction currently exist to assist in providing delivery systems necessary to prepare prospective educators for successfully using technology (Marker & Ehman, 1989). Contemporary teacher education programs tend not to advocate a process of instructional technology as a planning procedure.

Minimal exposure to technologies in their preparation programs make it highly unlikely that most graduates of teacher education programs will develop interests in and facility with technologies once they are teaching in their own classroom. In general, most teacher education programs have limited access to adequate hardware and software with which to prepare would-be teachers (Cooler, 1989). Bork argues even more vigorously that teachers now coming out of schools of education have almost zero acquaintance with computers, because very few schools of education anywhere in the world are in a position to deal with this question adequately. He concludes that teacher education will not be successful until we have adequate curriculum material using the technology, at which point we will also need good materials for training the teachers to use these technology-based courses (Bork, 1991).

While teacher education continues to be one of the most critical components in the success of any instructional technology program, inservice activities provided by school districts must play a critical role in the process.

Sturdivant (1989) summarized some of the commonly acknowledged obstacles faced by school systems embarking on inservice teacher education for instructional technology:

- incentives are lacking for further training;
- teachers who take additional training are often unrecognized;
- amount of paperwork, leaves little time for staff development;
- teachers have limited opportunities to see model applications;
- teachers are isolated and have few opportunities for sharing;
- access to software is limited; and
- teachers still don't have enough computer access.

Sturdivant reported initiatives undertaken by her school system which showed that some progress had been gained in overcoming the obstacles. She then concluded that the first and potentially most destructive problem is staff turnover. There is a great demand in business and industry for good corporate trainers. Consequently, articulate and well organized teachers who understand instructional design and who know how to use technology effectively are likely to leave the profession for greener pastures.

USING TECHNOLOGY TO DELIVER THE TEACHER EDUCATION CURRICULUM

Brooks and Kopp (1989) argued that if teacher education is to meet its responsibility to prepare teachers for the information age, then teacher educators have a professional responsibility to provide leadership in developing the full potential of existing and emergent technologies in teacher education programs. They noted a lack of planning, coordination, direction, and support of research on the applications of technology to teacher education. Six significant contributing factors were identified:

- absence of coherence in preservice program design;
- the semantics of technology;
- funding priorities;
- costs;
- limited faculty development; and
- a lack of research on the impact of technology on teacher education.

In a review of research studies reporting technological treatment effects that improved teacher training, Brooks and Kopp (1990) identified 42 of 72 studies with the program theme "Demonstrates a Repertoire of Appropriate Teacher

Skills and Behaviors". With few exceptions the studies reviewed focused on the discrete technical skills of teaching. Program themes such as "Designs instructional methodology in media and technology appropriate to goals and objectives", and "Uses appropriate instructional materials, media, and technology" were lightly represented, even though they might arguably evoke better transfer toward the goal of effective utilization of technology in schools.

Many projects devoted to the use of technology in teacher education programs have involved mammoth outlays of financial and human resources to perpetuate the status quo, which is to say an emphasis on teaching behavior. Such projects stress, as do teacher education programs in general, interpersonal communication between the teacher and individual students. In reality the communication in most classrooms more often resembles mass communication. A number of exemplary projects focusing on other program themes were reviewed by Brooks and Kopp, and others are ongoing throughout North America and elsewhere. However, to emphasize the point of possible misdirection of priorities, we now review some projects which focus on the discrete technical performance of teachers.

Typical of such studies is one reported by the Iowa State University College of Education (1988). The electronic technology used was interactive videotapes. Emphasis was placed on developing sensitivity to several fundamental teaching behaviors, with an objective of building the skill of observation and assessment of teaching behavior. The improved writing ability of students indicated a gain in the use of technical terminology and sensitivity toward examples of effective and ineffective classroom teaching behaviors.

A program was developed at Utah State University using instructor-controlled videodiscs (Salzberg, Rule, Chen, Fodor-Davis & Morgan, 1989). The thrust was to provide training opportunities for staff in rural and remote areas who deal with students having low incidence handicaps. Included is the presentation of a five-step teaching sequence to assure that trainees will learn to carefully monitor student responses, reinforce accurate performance and correct errors. Other units introduce presenting information, motivating pupils, and solving problems. The investigators acknowledge that a key limitation of the system is that trainees' responses within the system are primarily verbal.

In reaction to the behavioral emphasis in developmental studies of the type just described, Copeland (1989) proposed the development of pre-student teaching laboratory experiences intended to assist novice teachers in the development of their *clinical reasoning* (thought processes that precede purposeful teacher action). The proposed simulation would be based on an empirically derived model reflecting the typical patterns of teaching and learning behavior that might occur in classrooms. Although the system would depart conceptually from earlier approaches by deriving its underlying assumptions from cognitive rather than behavioral psychology, preservice teachers would still be prepared for an historic world which reflects little or no suggestion of utilizing resources other than the teacher.

Two extensive projects reflecting the essence of Copeland's suggestion are worthy of note. The initial phase of a long-term project undertaken by Cleveland State University, (Azbell & Patterson, 1988) involved development of interactive videodisc technology intended to provide student teachers with practice in using a problem-based model of instruction to acquire the skills needed in the application of diagnostic/prescriptive reading techniques in the classroom. A project being developed at Michigan State University (Lampert & Ball, 1990) uses interactive video and CD ROM technology to enable prospective teachers to examine and interact with lessons taught by experienced teachers in authentic mathematical activity in school settings. The investigators propose that this will enable students to form their own hypotheses about teaching and learning, and to test those hypotheses against the wealth of data from the classrooms. It is tempting to contrast the detailed methodology of analysis which this project presumably requires to that used by developers of Intelligent Computer Assisted Instruction (ICAI) and expert systems.

A series of videodiscs has been developed by the Faculty of Education at the University of Alberta (Engel & Campbell-Bonar, 1989) to allow preservice teachers to formulate and explore classroom management strategies in a non-threatening setting. One disc, Classroom Management: A Case Study is designed to encourage beginning teachers to take a problem-solving approach to understanding one student's personal experiences and motivations and their effect on classroom and social behavior. Student involvement with the disc simulates teacher activity which could well take place over a period of days, or even weeks. However, another disc in the series, "Do I Ask Effective Questions? or, I Can Hardly Wait to Hear What I'll Ask Next!" (Campbell-Bonar & Grisdale, 1991), is once again based on the historic model of immediate teacher-student classroom interaction.

Despite the exemplary scholarship inherent in the majority of the developmental investigations sampled above, one is forced to contemplate the existence of "rear-view mirror" syndrome, as described by Marshall McLuhan (McLuhan & Fiore, 1967) in contemporary teacher education programs. "The past went that-a-way. When faced with a totally new situation, we tend always to attach ourselves to the objects, to the flavor of the most recent past. We look at the present through a rear-view mirror. We march backwards into the future" (pp. 74-75). On the whole the projects reviewed appear to do little to prepare prospective teachers for non-threatening, creative environments which encourage effective use of all available learning resources.

PROPOSED SOLUTIONS

Some recent proposals toward appropriate integration of technologies in schools and teacher education programs are summarized below. A limitation is that the proposals tend to lack suggestions for strategies which would involve the many diverse groups whose support would be necessary in order to make the plans operational. On a more positive note, if we examine the "solutions" collectively, a case could be made that adoption of an organic, humanistic instructional technology process is necessary if electronic technologies are to be effectively utilized to assist schools at all levels of education in accomplishing their mandate.

A "Whole Course" Approach

Bork (1989,1991) argues that the only way interactive information technologies can be used effectively in education at all levels is to develop entirely new courses in a variety of curriculum areas. The full potential of interactive learning technology cannot be realized without newly designed academic courses. Teacher education must be associated with each of the new courses developed, and the development of materials for teachers must be considered an integral part of the development of the courses. With the focus on full course development, "we can rebuild schools and universities with technology-based courses that were not possible with older technologies" (Bork, 1991, p. 379).

Instructional Technology: Tools; Systematic; and Systemic

Widespread changes will be required in order for available technologies to become effective tools for regular classroom activities, not just as add-ons to be studied and learned about. The role of computer laboratories in schools might well be reconsidered, if, as Salomon (1990) suggests they have become self-sustaining, entrenched, and taken-for-granted bases of power. The entire classroom structure needs to change in a way that makes curriculum, student learning activities, teacher behavior, social interactions, learning goals, and evaluation interwoven into a whole newly orchestrated learning environment. Certainly a desirable strategy to bring about the most effective use of technologies in education at all levels would be to to utilize the tools, systematic, and systemic metaphors of instructional technology as appropriate, on a school-wide and system-wide basis.

Teacher education programs might well consider the same approach. Based on the assumption that most preservice and inservice teacher education programs have not come to grips with what it is that they should be trying to accomplish, Brooks and Kopp (1989) suggest a systemic approach, combined with creative planning, to the design of teacher education programs. Teacher education programs must take the initiative in developing greater collaboration with the schools, professional teacher organizations and government agencies. Research and development within teacher education programs might also profit by initiating more projects which incorporate technologies to demonstrate the emerging role of teachers when using learning technologies, rather than introducing technologies as artifacts of study, or to promote a "rear-view mirror" approach to classroom activity.

Technology Integration for Mcdnstreamed Students: A Side Door Approach

The current North American phenomenon of *mainstreaming* or *integration* could ultimately provide a link for successful technology integration in the schools. The use of computers has reinforced the importance of individualized learning and has broadened opportunities for educators to provide equal educational opportunities, not only for students with special needs, but for all students (Wilson, Casella, & Wilson, 1989). Studies of research to improve the integration of technology to assist handicapped students in mainstreamed classrooms suggest that the entire school system needs to commit to using technology to deliver the curriculum and to develop and nurture academic skills at successive grade levels (Anderson, 1990-91). Of special significance are the following conclusions:

- successful computer lessons require the correlation of the software used with curriculum objectives and student needs;
- regular and special education teachers need to be actively involved with students' use of all types of software;
- teachers need opportunities to continually reflect on and to evaluate practice; and
- teachers need to draw on knowledge about students in relation to the potential contribution technology can make to curriculum and instruction.

Active Learning, Technology, and Restructuring - Synergy?

The potential synergy which might be accomplished through the integration of three contemporary thrusts is intriguing. Increasingly, educators and policy makers are recognizing the critical need to produce students who know how to think, who understand concepts and ideas, and who can apply what they learn, pose questions, and solve problems. This is accompanied by calls throughout North America for *restructuring* of schools in fundamental ways. Restructuring can provide a framework for changing the system as a whole, and thus create an environment within which particular reforms can be carried out successfully (Fullan & Miles, 1992; Norris & Reigeluth, 1991;Sheingold, 1991). As indicated earlier, the use of technology in schools is not presently tied directly to the improvement of learning on a large scale, and the full potential of the technologies is not being widely realized. Still, it seems unlikely that such ambitioua goals for learning and teaching can be met, unless accompanied by widespread, creative, and well-integrated uses of all available technologies, deeply integrated into the purposes and activities of the classroom. But the synergy can only happen if it is a system wide process. We cannot expect to see individual classrooms and schools change substantially if the other pieces of the system do not also change (David, 1991).

Echoes From the Past

If much of the preceding sounds familiar it probably is. The decades of the 1950s and 1960s generated a great deal of excitement related to mediated learning resources. We discovered that "In order to produce a good film, one must first make a correct analysis of the teaching task" (Miller, 1957, p. 14). We were reminded that it is easy to get the technology ahead of the objective but that: 'The better approach is to try to locate the fundamental educational problems (which certainly are acute!) and then to see how new techniques can help solve them.. .The emphasis must be not on the technique, but on the goals of education" (Miller, 1957, pp. 32-33). Miller, among others, also reminded us that in addition to examining the content of the curriculum, we should take a new look at the entire educational process, and that without fundamental new thinking we would be unable to solve the "crisis in education".

Later, William Clark Trow (1963) provided an outline for a "systems" environment as an approach for schools to gain optimal advantage when using the "new media". Trow's plan did provide a fundamental new way of thinking, and while it has not gained widespread acceptance in the education community, many of his suggestions are echoed in the "solution" proposals for the 1990s which we reviewed above:

> The question that faces educators today is not how any one of these instructional media can best be used in the schools as they now are, but rather, how they can best be fitted together, along with the school personnel, all to become not aids or adjuncts but components in an educational system. This is something more than training teachers to employ the new media-use the tools and operate the machines. The new technology requires that man [people] learn to cooperate with the machines. He [They] must know what each component can do, and so fit them into subsystems within the larger system. (Trow, 1963, p. 116)

Thus, the obvious task would be to coordinate and integrate available technologies as components and subsystems in a unified pattern of procedures, with the overall goal of enabling students to achieve desired instructional outcomes. Under such a system, Trow argued that there was little chance that teachers would suffer from technological unemployment, but stressed the necessity for a greater degree of role differentiation. Under Trow's plan the functions of school personnel would differ widely, as would the personalities and perceptions required for the various functions. But the staff functions would be performed by people, and Trow insisted that the schools could not and would not be dehumanized by the introduction of better technology.

SUMMARY

So what have we learned? Teacher education programs have been involved with "new", "newer", and "emerging" technologies for at least five decades, and there have been many impressive examples of effective utilization and integration of technologies, both in the schools and in teacher education programs. Still, there is nearly universal agreement that many technologies which have been quite successful in society have had only limited impact on the educational environment, particularly relative to instruction and the instructional process. Causes of "failure" have been frequently documented and some attractive solutions have been proposed, most of which implicitly suggest an instructional technology process, involving a synergistic combination of tool, systematic, and systemic approaches. The challenge remains to devise strategies which can unify the many divergent elements in order to bring about actual, not merely proposed, solutions.

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Distance Education in Schools: Implications for Teacher Education

Margaret Haughey

Abstract: The advent of sophisticated telecommunications technology In business and Industry and society's demands for technologically-literate graduates has led to the piloting of technology-based educational initiatives across Canada. Similarly, distance education, once considered a different form of education, has changed the ways learning opportunities for rural schools are organized, and has also provided opportunities for teachers to restructure classroom procedures to allow for more flexibility and greater student control of their own learning. These initiatives have Implications for teacher education including a reexamlnation of the models of teaching and learning which are prevalent In teacher-training Institutions, the Integration of media so that alternative technologies are experienced by student-teachers, and the exploration of philosophies of Instruction with an emphasis on the facilitation of learning. Student teachers must be not only competent in the use of more technologies, but also cognizant of the ethical questions which the use of technology involves,

Resume: L'avenement des telecommunications perfectlonnees dans le milieu des affaires et dans I'lndustrle, et unesocietedemandant que lesdlpl6mes universltaire solent experts technologues, sont a I'origine d'un projet pllote de formation basee sur la technologie, a trovers le Canada. Ainsi, la formation a distance auparavant consldereе comme une forme d'education alternative, a change les habitudes d'apprentlssage des ecoles rurales et a perm is aux enselgnants de restructurer les methodes d'enseignement en donnant plus def lexibilite et en offrant aux etudlants un mellleur contrdle de leur propre apprentissage. Ces Initiatives ont aussi une portee sur la formation pedagogique en provoquant la re-evaluation des modeles d'enseignement et d'apprentlssage predomlnants dans nos Institutions pedagoglques. Elles proposent ('integration des medias afln que I'etudlant en pedagoglepuissesefamiliarlser avec les technologies alternatlvesetpuisse explorer les nouvelles philosophies de formation et de perfectionnement des methodes d'apprentlssage, L'etudiant en pedagogle doit non seulement avoir ('expertise necessalre a la manipulation des technologies m odernes mais II doit egalement etre consclent de toutes les questions d'ethlque que cette utilisation peut soulever.

The advent of ready access to sophisticated telecommunications technology is changing the face of education in Canada. Not only are schools now required to prepare students who are technologically literate, educators have begun to see the potential of distance education strategies for providing better and more diverse learning opportunities for students. Both of these initiatives have implications for teacher education.

The small rural high school in Canada is changing. Once forced by lack of qualified staff to offer only core subjects to its senior year students, today the school is able to provide a much greater range of course offerings while maintaining a high expectation of student success, and is able to do so in ways which better meet the varied learning styles of students. These changes have come about through the addition of distance education learning strategies. In Alberta, over half the high schools are small with less than 150 students and with 5 to 12 teachers, (Alberta Education, 1990a) a pattern that is not dissimilar across the Western provinces. Many teacher education students come from these schools and will return to teach in a rural area. They need to know how times are changing for rural high schools,what the possibilities are, and what they should consider in designing learning opportunities for their students. They have the potential to transform education in rural high schools.

As Knapper and Cropley (1991) note: "Despite the growth of distance education worldwide, there are still very few programs for training teachers in appropriate pedagogical strategies" (p. 102). Many of the graduates of teacher education programs are presently unprepared to use telecommunication technologies with their students. Few at the high school level have been introduced to any concept of teaching which does not involve the teacher in exposition and coaching. As student teachers, they have been evaluated for their ability to determine objectives, provide an anticipatory set, model the learning, provide practice, evaluate the learning and bring the lesson to closure. Their focus has been on teacher-centred learning. Furthermore, familiarity with media other than print such as audioconferencing, laser discs, and computer-managed learning is still relatively rare. But the situation is changing rapidly and therefore teacher education has to change also. Through examining initiatives in distance education at the school level, implications for changes in teacher education programs can be identified.

The Changing Landscape

During the last three decades, the gradual change in Canadian demography from that of a predominantly rural agricultural population on farms and communities strung out across the prairies and along the coasts of Canada, to one where the population is increasingly urban has accelerated. Economic decline in the farm industry, greater opportunities for employment and education in larger urban centres, and a declining birth rate have all been identified as contributing factors to this population flow. These shifts in population are occurring at a time when there are rising educational expectations for entry level to the work force, and a more informed population on educational matters. The most immediate impact of these changes has been on the continuing viability of rural communities.

For many communities, retention of the local school is considered a mark of community stability and a potential enticement for the relocation of industry. Hence, local school boards and provincial governments have been petitioned to help ensure that these small schools are able to provide a level of education equivalent to that available in urban centres. At the same time, the reform in education movement with its emphasis on testing and academic achievement coupled with business and industry's demand for a greater emphasis on science subjects in the senior years have resulted in provincial curricula which require greater numbers of specialist teachers at the high school level.

Canada is not alone in facing these pressures. Barker (1986) listed similar reasons for a comparable situation in the United States. These included the crisis in the agriculture, the drop in oil prices, the reduction in numbers of people entering the teaching profession, and the greater numbers of courses required for high school completion. In the United States, the move to the cities had resulted in school closures and consolidations as fewer people were available to carry an increased tax burden including rising educational costs (Stephens, 1986; Williams, Eiserman, & Quinn, 1988). Australia with a small population in proportion to its land area is facing similar issues of rising educational expectations and population fluidity (Conboy, & D'Cruz, 1988).

Population shifts have also had an indirect impact on urban schools. The downturn in the Canadian economy which has led to cost-cutting measures such as staff lay-offs and the application of technological efficiencies, has influenced numbers of students to return to high school and upgrade their qualifications. Many high school students are living on their own and employed full or part-time: They want courses offered at times which fit in with their work demands. As well, due to the closure of some specialist vocational programs, the student clientele has become more diverse in terms of academic achievement and more demanding in terms of motivation. As high schools have begun to reexamine their programs to identify ways which will better meet these student needs they have turned to technologies as a means of developing alternative instructional strategies which would allow for greater student independence and autonomy.

The Provincial Response

Provincial governments have been involved in developing instructional alternatives which would allow students access to high school courses since 1919. All provinces except Prince Edward Island, and Newfoundland which had closed its correspondence programs in the mid-70's, have provincial correspondence schools. The most common format was for the provincial correspondence school to be responsible for the development of the instructional materials. The course materials were sent out to all students who registered. Students sent completed lessons to the school where teachers marked the materials and returned them to the students usually by mail. For students in rural high schools, the service allowed them to obtain high school credits in courses which were unavailable at their local high school and many took advantage of the opportunity afforded them. For 1989-90, Alberta and Ontario each registered over 12,000 secondary school age students in distance education while British Columbia, Saskatchewan, and Manitoba, registered between 4,000 and 6,000 students each (Haughey, 1990, p. 2). Although there had been major changes in distance education in the post-secondary sector from Radio Farm Forum in the 1920s, to television in the 1950s and computers and satellites in the '70s (Muggeridge, & Kaufmann, 1982), few of the provincial correspondence schools were able to explore these alternatives due to lack of funding.

Faced with increased demands for greater access to educational programs, and concerns for equity among rural and urban schools, provincial governments began to explore ways in which high quality programs could be made available to all high school students through the use of communication technologies. British Columbia focused on the regionalisation of the correspondence school services so that marking was done by local teachers paid on a piece-work basis, and administration was handled by a local school district. Each regional school has explored a variety of technologies including fax machines, computer networks and audioteleconferencing. The advent of the Saskatchewan Communications Network, an interactive video system involving satellite and microwave broadcasting has quickly expanded the options now available to schools in that province. Manitoba Educational Television, begun as a pilot project in 1984, provides a variety of broadcasts which support in-school and provincial correspondence programs throughout the province (Simard, 1989). The Small Schools Project, begun in 1985, initially used audioconferencing and some computer conferencing on the provincial computer system. Using combinations of audio and computer conferencing with print materials, 15 courses were taught each semester to students in over 20 schools across 15 subdivisions in 1988 (Education Manitoba, 1988, p. 34). In 1990, piloting of courses to 45 sites using interactive satellite broadcasts was begun. Newfoundland has begun to use the province's extensive audioconferencing network on a regular basis for high school instruction. As all of these projects indicate, access to modern communication technologies has the potential to transform thinking about high school instruction.

The Alberta Situation

In 1987, Alberta Education initiated a pilot program in southeastern Alberta involving 10 school jurisdictions and ISschools. Called the *Distance Learning in Sjnall Schools* project, it was designed to explore the advantages of locally-based teacher markers, and the impact of technologies such as fax machines and audioconferencing on the provision of high school instruction. The project was so successful both in the increases in numbers of students who registered for courses, and the numbers who completed their courses successfully, that the project was expanded to 28 schools in its second year (Clark & Schiemann, 1990; Gee, 1991). Also in 1988, Alberta Education began a second pilot project, *Distance Learning Project North,* this time in the northwestern sector of the province This project focused on the implementation of computer managed learning software for all high school mathematics courses which accessed a test bank and provided individual tests, as well as recording student scores on an appropriate record keeping system; the use of an audioconferencing and audiographics system; and the development of partnerships among the participating jurisdictions. In 1989, the Minister of Education announced an equity grant for 145 small schools throughout Alberta "to provide qualifying school jurisdictions with funding to enable low enrollment senior high schools to offer a wider range of student courses than under present circumstances" (Alberta Education, 1989, p. 2.2).

Since then, most jurisdictions have joined one of six consortia for the provision of distance education while a small number have chosen to offer distance education within their own jurisdictions. In general, students use the provincially prepared instructional materials, and are often required to attend distance education classes where they work on these materials independently. They have the active support of a teacher on staff and the ability to call their teacher-marker for advice and assistance. The students send lessons by fax and usually receive a reply within 48 hours. The CML data base system is being expanded from mathematics to include other sciences. Some jurisdictions have transferred some of the mathematics programming to a CAI-CML format on Macintoshes, and the extent of audioconferencing varies with the jurisdiction (Hough, 1992).

In describing the variety of models which have been developed, the Alberta Distance Learning Centre has focused on systems of delivery. They have identified four models:

- The first is the traditional correspondence model where students return materials directly to the provincial centre for marking.
- The focus of the second model is computer-managed learning. Students work on their distance education materials under the supervision of a teacher who monitors their use of the CML system for assignments and examinations, and provides additional marking and assistance as necessary.
- In the third model, students' distance education assignments are marked by teachers who are either on the school staff or who are hired specifically to provide this service, often on a part-time basis. While the first model presumes that the student will work independently with little or no formal supervision or support in school, the third model includes the provision of a distance education teacher who monitors the progress of the student and supervises the work often in a special distance education room.
- The fourth model, is really an expansion of the third model, with a network of schools all of whom have implemented the third model, linked through a central consortium director, and all potentially using the same teacher markers (Alberta Education, 1990b, pp. 10-14).

Although these models highlight some of the differences between the traditional correspondence model and the new distance education versions, such as the greater attention to student support and supervision and the use of local teachers as tutor markers, they are unable to surface the pedagogical issues surrounding the implementation and integration of distance education. In a review of schools and consortia in Central Alberta, Hough (1992) described a variety of formats for the provision of distance education from students studying independently with little supervision to students from different schools who formed teleconferenced "classes" and were taught by a teacher at yet another school. There was similar variation among the tutor-marker employment practices used by consortia. Some consortia used an agent board to hire and assign all tutor-markers, while others left those functions up to the individual jurisdictions. Some encouraged tutor-markers to be part of the school staff, while others employed part-time people who worked from their homes. What is most notable is the variety of ways in which schools and consortia addressed the provision of distance education.

The Teachers' Response

Although there was a variety of administrative arrangements for the implementation of distance education in the schools, teachers varied less in their response to distance education. Most of the teachers and principals to whom Hough (1992) spoke felt that while face-to-face instruction was the best method of instruction, a good distance education program was an acceptable alternative. Although he did not explore their reasons for this conclusion, some principals and teachers spoke of their concerns that the provision of distance education would deplete the numbers of students taking regular instruction and hence lead to staff layoffs. One principal explained that the only distance education courses he allowed his students to take were those for which the school could not provide classroom instruction. In contrast, another administrator, faced with this concern by teachers, replied that perhaps students were voting with their feet and classroom instruction needed to become more interesting. Underlying teachers' concerns were suggestions that declining enrollments caused by provision of distance education courses would deplete small staffs in that students would opt for distance education because it seemed easier; that the design of distance education materials was a series of read and do worksheets which denied the complexity of the teaching act; and that distance education could not provide the personal coaching available in a regular classroom. If distance education is to be accepted as a legitimate instructional/learning strategy for students, then these teacher concerns need to be addressed.

The Impact on Staffing

The first concern identified by teachers was the impact of distance education on staffing. Schools throughout the consortia and within jurisdictions adopted various ways of restructuring "school" to accommodate distance education as an alternative within school rather than an alternative to school. No school in Hough's study (1992) had ,to lay off teachers due to the impact of distance education. Instead, principals sought to work with other schools (the Distance Learning Centre Model 4) to ensure that there was sufficient employment for all their teachers. In a school where students were permitted to take any course they chose, the principal noted that the demand was for a widening diversity of courses. He pointed out that the school was now better able to provided appropriate instruction in courses of interest to non-university or college bound students; courses which the school could not have offered without distance education. Many principals were able to provide alternatives without staff reductions; those principals who were least supportive of distance education seemed to find the threat of declining enrollment leading to staff layoffs to be a convenient rationale for retaining the status quo.

Principals could try to maintain the status quo and limit distance education, thereby negating promises of access and equity, or they could seek alternative structures which would employ teachers in ways other than as a classroom teacher. Preferences for established routines was another aspect of this issue. While some principals chose to consider their students as a captive audience, and assigned them all to classroom instruction, others gave teachers the option of using distance education in a combined class of a single grade but multiple ability levels. In some cases, teachers chose to teach the average and high ability students directly, while lower ability students were assigned to distance education (Clark & Haughey, 1990). This marginalization of those students who had the most difficulty reading and staying on task meant that discipline problems, absenteeism, and non-completion were likely outcomes, fueling the teacher's reluctance to allow high ability students to become involved in distance education. Also, some teachers found it difficult to move away from the presentation of ideas to the facilitation of learning.

Many teachers at the high school level saw themselves as subject specialists. They enjoyed an instructional format which involved them as expert in presenting information and engaging students in questions. When their students took a distance education course, these teachers spoke of their loss of enjoyment of the drama of teaching, and their loss of frequent contact with "good" students who did not need their advice and assistance. They found it difficult to spend time aiding students to find information rather than in providing the information directly themselves. They were concerned that the students might not absorb the information correctly or see where it related to other ideas. They worried about their ability to monitor individual learning. This diversity was most evident to them in their loss of control of the pace of instruction; instead they were faced with constant marking which was inevitable when every student was at a different place in the course.

Implications for Teacher Education

There are immediate implications for teacher education. While elementary teachers are expected to provide a facilitative environment which allows students to progress at their own pace, high school teachers have tended to stress the transmission of information to a much more homogeneous group of students. Distance education provides an opportunity for teachers in training to explore alternative pedagogical approaches to learning. Such training needs to involve greater attention to student characteristics such as learning styles, as well as to teaching and management strategies which allow for individualization of instruction.

The Loss of Interaction and Immediate Feedback

Teachers were concerned that distance education did not allow for the coaching and interaction of a regular classroom. Earlier experiences with correspondence programs with a failure or non-completion rate of close to 70% (Gee,

1991) were taken into account when the first pilot program, *the Small Schools Project,* was designed. A staff member in each school was assigned to be the distance education coordinator and was responsible for monitoring student progress and providing advice and encouragement. A completion rate of close to 90% (Hough, 1992) confirmed the importance of personal support for students who were unused to taking responsibility for their own learning.

The specific circumstances for distance education students seemed to vary by school, and was influenced by size of school population, number of distance education students, availability of staff, and appropriate facilities. Hough (1992) described schools where students taking distance education courses studied independently and were supervised on a casual basis by a teacher who had other responsibilities. Sometimes these students sat at the back of a classroom and obtained help when the teacher was available. Some studied in the library or counsellor's office and phoned or faxed their teacher-marker for assistance. In these situations, distance education was viewed as an independent alternative to class instruction.

Hough also described schools where principals had reorganized school timetables so that all students taking distance education courses had these courses at specified times, and were expected to study in the distance education room under the supervision of a specifically assigned teacher. This teacher monitored their work, provided advice and encouragement, faxed their assignments and recorded their grades. For educators in these schools, the provision of support and assistance was considered integral to success in distance education. They saw distance education courses as needing teacher intervention to be satisfactory learning experiences.

In those situations where students were assigned to a distance education room, the designated teacher was often required to supervise students who were simultaneously working on a wide range of courses. Students could call their tutor marker or talk to another teacher in the school when they had a specific problem which the supervising teacher could not address. Students' success rate, which varied little among all the schools Hough (1992) surveyed, offers some evidence that while students benefitted from the concern and support for their progress provided by the distance education teacher, they did not require the specific coaching and interaction which the teachers thought was necessary.

Implications for Teacher Education

As Goodlad (1990) has pointed out, much of what passes for instruction in classrooms involves extended amounts of teacher talk, a point identified much earlier by Jackson (1968). Teachers need to be more cognizant of and proficient in providing learning opportunities which engage students in actively constructing their own understandings from the information available. They should also know how to help students assess critically what they read so that they can move more quickly beyond assimilation of the facts to integration of the information.

The Design ofDistance Education Materials

Teachers' concerns about distance education were most evident in their reactions to the use of prepared materials and their lack of knowledge of the instructional design process. According to Ullmer (1989) the most common view of instructional design

> usually entails a teaching regimen which emphasizes instruction-centred, verbal exposition; an associated image of the learner as a largely passive, word-processing, fact-storing mechanism; and a governing ideology that calls for little more than orderly information transfer and assimilation. The implied instructional design mandate is to supply materials that enable teachers, like farmers, to "cover the ground", (p. 96)

Kerr (1989) in an examination of teachers' reactions to technology, pointed out that the highly structured, systematic format closely associated with instructional design is in many ways the antithesis of what we know about teachers' planning strategies. In reviewing a variety of studies on teachers' approaches to planning, he concluded that "in all these cases, emerging evidence highlights aspects of the teacher's work that are ambiguous, uncertain, difficult to cast into the molds educational technologists have wrought" (p. 8). Kerr went on to point out where teachers put most emphasis in their planning for instruction: "Teachers' ideas of their work, then, focus on the 'wisdom of practice,' and on the value of their individual connections with students" (p. 8) and he stressed that teachers "create for themselves a classroom world which reflects both their assumptions about teaching and their preferred ways of working with students" (p. 8). It is little wonder that teachers were dismissive of materials which did not match their own designs for instruction and which did not include much personal interaction with individual students.

Teachers in planning for classroom instruction most often begin with a specific teaching strategy related to a particular concept or set of ideas. As they teach they try to include examples which will provide learning bridges for their students. Sometimes the strategy involves using media other than print, chalkboard, or overheads but in many classes, especially at the high school level, the textbook is still the most important resource for students and teacher. It is not surprising then, that teachers found the easiest way to incorporate distance education materials into their classroom teaching was to adopt them as texts.

Unlike teachers' classroom practices which are essentially private and temporary (Jackson, 1968; Lortie, 1975), distance education materials are public documents and are thoroughly evaluated before they are released for publication (Thorpe, 1988). In Alberta, this usually begin with the appointment of a project manager, a practicing teacher or teacher consultant who is seconded to the Distance Learning Centre to develop a modular outline for the course based on the provincial Program of Studies. This outline details the instructional design of the course including both the sequence of topics and the probable instructional strategies for each topic. Once this design outline has been approved by an advisory group, a number of teachers are hired to work on development of individual modules, usually over the summer period. After receiving information about appropriate print designs, the teachers work collaboratively to write the text and questions and design assignments for each module. The teachers vet each other's work, providing advice and critiques on a weekly basis. In this way the module writers develop similar ways of addressing students, consistency in expectations for students, and a similar level of language use for the modules. These modules are then reevaluated for consistency of development, for appropriate progression of ideas, for accuracy of content, and for variety in level of questioning from recall to synthesis and from concrete to abstract. Where necessary, the modules are rewritten to meet these expectations. They are evaluated for gender, and racial bias. Finally they are organized to meet design specifications such as the amount of white space, standardized levels of headings, and use of graphics and drawings. After a final vetting, they are printed and packaged (Stanley, 1990).

These distance education course modules differ from textbooks in a number of significant ways. First, they are developed by experienced practicing teachers to meet the particular objectives of the provincial curriculum so they include all of the required areas and are designed to extend the knowledge base learned in previous grades. At the same time, when a unit requires knowledge of a previously learned specific procedure or skill, an optional, mini update unit is provided for those students who wish to review their knowledge prior to proceeding. The modules themselves are designed to set out clearly what the student is expected to learn through a variety of activities, and in-text assignments, where the student can test how much has been learned before moving on to the next section are provided. Such a format, however, is not limited to read, think, and write exercises. Just as is possible in teacher-directed instruction, a full range of instructional strategies including problem-solving, games, discovery learning and information-seeking is provided to engage learners in tasks which will likely help to facilitate their learning. Activities are chosen to cater to different learning styles, thinking levels and interests and where possible a number of alternative exercises are included to provide choices for the learner. At the end of a unit, both "extra-help" and "enrichment" exercises are provided. As Shulman (1987) has pointed out, experienced specialist teachers have developed a repertoire of information specific to the content area including knowledge of likely student mistakes, preferred instructional strategies for specific content areas, and knowledge of the teaching structure of the subject as distinct from the structure of the discipline. When distance learning materials are developed by a cadre of such teachers, the instruction is likely to be richer than that provided by a single teacher who has had fewer opportunities to teach that curriculum.

Implications for Teacher Education

One of the most important aspects of teacher education is the development of expertise in the design of instructional materials. Students are required to be able to plan for instruction in ways which take into account individual students' learning styles, their level of prior knowledge, and stage of development as well as showing evidence of their own knowledge of the subject matter. Often, students begin with teaching plans which are highly teacher controlled. Unfortunately, since practicing teachers have limited opportunities to observe each other teach or to discuss the merits of various teaching strategies, their opportunities to develop a wide repertoire of teaching strategies are limited. This is especially so when they teach in small schools where they may be the only specialist in that area on staff. Too often, the emphasis in teacher education has been on the development of generic teaching skills such as the development of objectives, the presentation of information, the provision of practice questions and the closure of the lesson. These skills focus on the teacher rather than the learner and, while important, give no recognition to the development of what Schulman (1987) referred to as the teaching structure of the subject. More attention needs to be given to the development of strategies which focus on the learner and the pedagogy of the subject.

Approaches to Learning

Many teachers support a curriculum design which is based on a systems model of objectives, activities and evaluation, and subscribe to a theory of knowledge as information dissemination. For these teachers, teaching involves transferring information to learners. Other teachers, who assert that the curriculum should be designed to allow individual students to construct their own understandings, subscribe to a constructivist theory of knowledge. For them, knowledge is constructed by individual learners who make sense of information in terms of their own experiences and teaching is the facilitation of this learning. In these situations, the classroom teacher's task is to provide enough information to challenge students' thinking, to help them work through information critically, and to relate information to their own experiences. At first glance, it would seem evident that systematic teachers would support the use of distance education materials while constructivist teachers would not. But the increasingly sophisticated designs used in distance education materials are based on a learner-centred philosophy which provides support, encouragement, and instant feedback to students through solutions, diagrams, explanations, and guides, and allows for student choice (Stanley, 1990).

Facilitator manuals which outline various ways to use the materials are also provided to teachers so that the materials can be used effectively by teachers with differing philosophies. The facilitator manuals stress the importance of each component of an open learning system: The learning package, student support, and management. The need to be cognizant of student reading levels is also addressed. Teachers are encouraged to make their teachingmore learner-centred by promoting learner self-confidence and providing support and guidance to individuals and small groups, and more student-active through the use of strategies which involve students in designing and working through problems and questions.

In an earlier review of distance education practices in schools, Haughey (1990) identified four learning models based on distance education. These may provide a basis from which teachers can explore their curricular assumptions and the patterns of interaction which direct their teaching. These four models are as follows:

- Teacher-controlled, whole class, learning;
- Teacher facilitating, small group learning;
- Student-controlled, teacher-supervised, learning; and
- Student controlled, independent learning.

In the first model the teacher continues to teach the class as a group and uses the distance education materials as a text. The teacher introduces the lesson, the students work individually on the unit, the teacher brings the unit to closure, provides a review, and evaluates the students' work. There is high teacher control of the learning situation, and block pacing. The benefits of distance education are in the detail and variety of the individual units which are usually designed to be more interactive than a textbook. Teachers who were required to teach a subject which was not their specialization found this method helpful as did teachers who wanted to explain concepts or introduce ideas themselves in ways they thought would be clearer for students than the introductions provided in the distance education materials.

In the second model, the teacher divides the class into small groups based on student ability and allows these groups to proceed at variable rates. While the teacher still introduces new units and monitors and evaluates students' work, the student group becomes the learning unit and often uses cooperative learning strategies to ensure that all members of the group are all able to proceed together.

In the third model, students work on distance education materials independently or in small groups and the teacher evaluating their work may not be the teacher in the classroom. The classroom teacher works with students individually but does no large group instruction. Where the teacher is a specialist in the subject, students in difficulty may receive individual assistance and the teacher will evaluate the students' work. Where the teacher is not a specialist, the teacher may provide individual encouragement and assistance with general comprehension or management questions but will encourage the student to contact the teacher who will evaluate their work for specific advice and direction. Students may pace themselves and keep their own record of marks for their work or the teacher may be required to monitor and chart the students' progress, fax assignments and record grades. In this model evaluation is separated from the other aspects of instruction and often coaching or tutoring was also provided by someone other than the classroom teacher.

In the fourth model, the student is solely responsible for completing the distance education materials. There is no assigned classroom where the teacher is responsible for assisting students, monitoring their pacing and recording their grades. Instead, some students sit at the back of a regular classroom while another class is in progress or in the library, while others study at home or work. The student has the opoortunitv to contact the teacher who will mark their assignments for advice and tutoring, hence the most common name for these teachers who are not assigned as a classroom teacher is the "tutor marker", highlighting the two most common functions which they provide.

Although these models highlight the progression from teacher control of the pace, content, presentation, and evaluation of instruction to student control of the pace of instruction, the Distance Learning Centre's control of the content and presentation, and the tutor marker's responsibility for evaluation of the work, they do not include the situations where teachers are given combinations of students, sometimes a mixture of distance education and face-to-face students for the same subject. In some schools, teachers who did not have enough classes for a full teaching load were assigned to be tutor markers for students in other schools. Another alternative was for teachers who had few students in their classes, to be assigned distance education students from other schools who registered for the equivalent distance education course and were considered part of that class. In some of these "classes", the teacher taught both their in-school and distant students using the prepared curriculum materials from the Distance Learning Centre. In situations where in-school teachers were markers, students were encouraged to contact the teacher for advice and encouragement. Although some teachers treated this situation as similar to an independent study, others were able to integrate distance educations materials into their regular teaching. Some teachers wrote additional materials, tests and assignments to match their own teaching interests, and some teachers made videotapes of science experiments to help their distant students' understanding.

What is evident in these uses of distance education materials as part of classroom instruction was the ways in which teachers were able to move beyond the use of the distance education materials as texts. Some teachers focused on providing a supportive climate for learning while others thought it essential to provide bridges between the new materials and what had been taught before. These teachers were critical of the way some concepts were presented and sought to enhance and simplify student learning by teaching the concepts themselves. As teachers became more familiar with the structure of the materials, their concerns lessened. Because the distance learning materials included all the concepts and skills required for that course, some teachers permitted students to proceed at their own pace rather than be tied to the progress of the class (Clark & Haughey, 1990).

Implications for Teacher Education

Teacher education programs should not only provide opportunities for students to explore differing philosophies of education but should also model learner-centred, student-active education.

The variety of strategies for the provision of distance education which have been developed by practicing teachers highlights the importance for teachers of being able to recognize and articulate their own assumptions about teaching and learning, of recognizing which strategies might be best in which situations, and of being competent in the provision of the strategy itself. These teachers had well developed repertoires of teaching strategies which complemented their understanding of the subject matter. Perhaps too much attention has been paid to the development of generic teaching skills at the expense of developing skill repertoires which are linked both to specific subject fields and to teachers' actual planning strategies.

Using Various Media

Teachers involved in distance education most often work with combinations of print; fax; telephone; videotape; audioconferencing, often with audiographics; and computers. Of these, the combination of print, fax, and telephone is the most common. Where materials have to be accessible to students whether studying at home or at school, and regardless of economic background, the addition of specific hardware technologies is limited by the level of acquisition of society in general. Now that videotape players are easily accessible, distance education materials should include more visual materials to enhance the understanding of students. In one school, the science teachers had made a number of videotapes to help students see the experiments being performed. Such tapes are easily made and can be updated as teachers obtain feedback about what students need to see. They also have the advantage of instant replay and multiple repetitions which are controlled by the student learner.

Audioconferencing among schools, which had been specifically encouraged in the *Distance Learning Project North* pilot because of its success in the *Small Schools Project*, has not been implemented in Alberta as widely as originally planned. Mainly, this has been due to the need for coordination of school timetables within and across jurisdictions, a difficult task in small schools in particular. Where teachers have used audioconferencing to support and extend distance learning materials as well as where audioconferencing is the main teaching medium, students and teachers have found the system to be successful. (Bohnet, 1992). Teachers have found students to be appreciative of the interactive nature of their instruction, and the intervention of an on-site moderator to monitor student behavior has not been necessary. The use of audiographics, especially where they are transmitted and stored ahead of time, has also been an additional bonus in enhancing students' learning. Successful audioconferencing is highly interactive, both student to student across sites as well as student to teacher. This means that each student has to be responsible for reading and working independently through much of the material which the teacher would proclaim in a classroom situation.

In general, the use of computers has been confined to accessing the CML mathematics data base for tests, exams and scoring of responses. School boards expressed some dissatisfaction with the particular generation of computer which was first introduced and which within a year or two needed upgrading to handle the increasing capacity of the database or fast retrieval for multiple stations (Haughey, 1992;Gonnet, 1991; Hough, 1992). Although most of these problems have been overcome, the budgetary implications resulted initially in somewhat less support and interest in sustaining the CML program at the senior administrative level. At the same time, those teachers who have learned to use the program and set their own parameters for their students, have found the program to be very helpful in encouraging and sustaining students' interest in the subject. The mathematics program also acquainted teachers with a range of resources from graphics programs for thecomputer, to videotapes which illustrated difficult concepts. In reviewing teachers' use of CML, Clark and Haughey (1990) found that all four learning models were present suggesting that the philosophy of the teacher towards distance education was the major factor in the implementation of this technology.

Implications for Teacher Education

Across Canada, a number of pilot projects are in operation in both elementary and secondary schools. They stress technology based education, independent study, and integrated multi-media systems such as the use of sophisticated authoring programs to involve students and teachers in designing appropriate learning events. As educators take seriously the demands to provide appropriate technological education, the numbers of these projects will increase and teachers need to be prepared to work with a variety of media to create new learning opportunities for students.

Teaching institutions need to include instruction involving a variety of media. Kerr (1989) also raised this point:

> Teacher training clearly needs to incorporate more information about and experience with educational technology, both hardware/software and process. But presenting these concepts in an isolated class reduces new teachers' abilities to see how educational technology might be connected with their own teaching field, (p. 12)

First, they need to model it themselves thereby giving students experience in this form of-learning and some practice in appropriate designs for learning, and where possible, beginning teachers also should have opportunities to experience the successful use of technology in the classroom.

Second, media should become an integral teaching medium since it can enhance student opportunities to learn at their own time, place, and pace. Third, teacher education graduates should be aware of the ethics of technology (Franklin, 1990) and consider technologies as more than mere tools for extending instruction. Just as they should give greater attention to various models of instruction, beginning teachers should also have explored the implications of instructional design and distance education as technologies themselves. While these technologies have the potential to focus on the possibilities for learner-centred education, they can also be used to provide a more covert form of teacher-controlled mass education.

Fourth, students in schools are already media-literate. Not only are students sophisticated consumers of video, and experts at telephone talk, they are increasingly at home with computer programs. Beginning teachers need to better understand how these technologies can be integrated for instruction. The use of recent innovations such as dbases on CD-ROM and video discs is expanding the options available for teachers (Gee, 1991). Teachers have to develop strategies for working with distance education students which include more of these options. Since teachers' own discipline-specific knowledge is a major influence on the ways they might employ distance education, moreemphasis needs to be given to models of teaching other than the generic teacher-centred model. Finally, distance education may be the avenue for teacher continuing professional education. Like their distance students, non-urban teachers are often penalized by lack of access to university programs. Using a variety of distance education formats to provide access to graduate programs, would not only provide equity to teachers in terms of programming, it would also help them continue to explore teaching and learning options which they could then implement in their own schools and jurisdictions.

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Collaborative Instructional Design as Culture-Building

Katy Campbell-Bonar
Alton T. Olson

Abstract: Despite the critically reflective work of the past decade, we think that many theorists have not gone far enough In urging a re-orientation In design models In which Inter-Instltutlonal teams must work cooperatively over a long period of time. One essential way in which the design process in a collaborative team approach differs from the existing rational systems approaches Is In the creation and use of cultural tools during the design process. The traditional models, which are linear and algorithmic, fall to take into account one of the unique products of a collaborative design process: that of culture-building. In this paper the social processes of culture-building during a collaborative instructional design team effort will be examined retrospectively, We believe that a new perspective on collaborative instructional design will help project managers and instructional designers become attuned to the social interactional nature of the team-based instructional design process.

Resume: Malgre les serieuses remises en question des dlx dernieres annees, nous croyons que les theorlciens ne sont pas alles assez loin en proposant une re-orientation des modeles au sein desquels les equlpes inter-lnstitutlonnels dolvent travailler en collaboration, durant de longues perlodes. Une difference majeure entre le processus de cooperation entre equipes et les systemes existant est la creation et ('utilisation, au cours de la creation du modele, d'outlls culturels. Les modeles tradltionnelssont lineaires et algorithm iques et ne tiennent pas com pte des rejallllssements exceptionnels que le modele collaborateur peut avoir, c'est a dire la collaboration culturelle. Dans cet expose, I'evolution soclale de la collaboration culturelle en cours de creation du modele cooperatif de formation sera examinee en retrospective. Nous croyons qu 'une nouvelle perspective du modele cooperatif de formation pourra aider les chefs de projets et les concepteurs de modeles de formation a mieux comprendre la nature interactive du milieu social du modele de formation base sur le travail d'equlpe.

> What the artist and the creative scientist have in common is that both are makers of form, one qualitative, the other theoretical, who offer vis images of the world. When the images are well-crafted they provide compelling schemata that capture both our attention and our allegiance. The forms we call art and science, rite and ritual, not only provide schemata through which we experience the world, they are also forms through which we represent it...
>
> Elliot Eisner, p. 16, 1988

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Traditionally, instructional technology has evolved and has seen itself as a subculture within its fields of application, such as teacher education. By this we mean that instructional technology has not been considered an integral part of teacher education, often existing, if at all, as a support unit in faculties of education. Efforts to bring faculty into the instructional technology subculture have typically resulted in short term involvement from which no lasting changes in perspective emerge. In this case, the outsider is *acculturated* to the prevailing rational view of instructional planning. Acculturation is a one-way transmission of knowledge and skills which often entails no lasting commitment to the value system of the subculture. In the *collaborative* design project described in this article it became evident that acculturation, which presumes the existence of a larger culture, did not adequately characterize the process in which we were engaged. For us, characterizing the process of collaborative instructional design as acculturation was inappropriate: the nature of a collaborative design process reflects *culture-building* instead. Admittedly, there must be aspects of acculturation in a project such as this, for example, learning to use specific technical language. However, in our experience culture-building was an important complement to acculturation in the hard work done at the beginning to make the explicit plans (of an instructional system) part of the implicit, tacit knowledge of the team members as an interactive, recursive process in which the participants shape artifacts and process and are, in turn, shaped by them. Culture-building goes beyond team knowledge-building, which we see as making surface accommodations to the personal/professional agendas of individual team members. This may be one reason why "traditional" instructional design teams, working with linear, algorithmic models, are notorious in their failure to coexist without difficulties (Naidu, 1988).

In this article the authors propose an alternative to the view of instructional design as a rational, systematic process reflecting acculturation of design team members. In describing a successful, collaborative videodisc design project *retrospectively,* we found that the characteristics of an instructional system did not fully reflect our experiences in the project. Our experiences were closer to the creative process described by Ivor K. Davies (1991) in another context:

> Attempts to make instructional development a craft or a science have supplied in the first case a heuristic and in the latter case a recipe or algorithm that has largely failed to realize the potential of ID. To a certain extent, the problem arises from a misunderstanding of the nature of art, craft, and science... (p 96)

Indeed, Davies has identified what for us became the tension in trying to reconcile our craft knowledge of teaching with the technical imperatives of systematic instructional design models: there is not a recognition of the importance of artistic endeavour in the creation of instructional materials. Our dissatisfaction with this still-prevailing view has also been voiced by other members of the design community: see for example Beckwith (1988) and Mitchell (1989).

EMERGING PARADIGMS IN INSTRUCTIONAL DESIGN

Emerging paradigms in instructional design seek, in part, to reconcile the rational view of design as product-oriented optimal blueprint and design as process-oriented and ontologically-based. At the same time as there is growing interest in the nature of teacher thinking, theorists such as Tripp (1991) and Schon (1983,1987) are exploring the possibility that designers may use different approaches at different times on different kinds of problems, and that the decisions may be at least partly intuitive (Tripp, p.5., 1991). In curriculum theory, a critical, interpretive understanding of instruction is exemplified by Joseph Schwab who describes the four *commonplaces* of learning: the teacher, the student, the subject matter, and the milieu. These four form the starting points of developing a *true practical knowledge*. This non-legitimated aspect of design is significantly different from an objectives-driven technical model according to Hlynka and Belland (1991).

> Even if an instructional developer is striving mightily to be scientific and systematic in the design of an instructional system, many of the decisions made in the course of development will be aesthetic, intuitive, experiential and phenomenological...Critical paradigms provide a mode of inquiry which can provide insight and information which goes beyond the possibilities of scientific inquiry... (into) the realm of art. (p 9)

In its transformative orientation this paradigm, along with elements of the situational-interpretive orientation, seems to best reflect Schon's view of design-as-dialogue and Banathy's (1987) reconceptualization of design as dialectical, spiralic, and holistic, and may provide a conceptual framework for examining the collaborative design process as one in which participants engage in the construction of a meaning-full instructional plan through conversation.

As Davies (1991) suggests, design involves a subtle and sensitive blend of art, craft and science according to the needs of the task *and the people involved in that task,* which culture-building underlies. Highlighting the design, development, implementation and evaluation stages of instructional design — in the belief that these somehow confer the status of scientific endeavour — is, in fact, reinforcing the craft side of what is essentially a creative act of inquiry (p 96). Collaborative design activities may contribute to this process by enhancing creativity and making it possible to generate solutions that will be considerably different from those generated individually.

Davies (1991) poses two questions for the field: *How can instructional design as a concept be communicated?* and, *What dimensions of knowing does it recognize?* We believe that a reorienting of the concept of instructional design to celebrate the role of creativity, imagination, reflection and collaborative conversation will better represent the essential *humanness* of the process.

Instructional design activity has moved from the behaviourist orientation of the sixties through a cognitivist orientation in the eighties to a more constructivist view in the nineties. This latter paradigm considers the mterrelatedness of the teacher and the learner, the essential aspect of the teacher-as-planner residing in the knowledge structures and instructional plans that he/she contains. In this sense, the teacher, partly by virtue of once having been a student, and partly by praxis, acts as the student's voice in the design of instruction. And the interaction of the learner's cognitive operations within the entire process of the instructional system leads the learner to construct new cognitive structures and operations (Streibel, 1991).

Lucy Suchman (1987), in exploring the user's interpretation of plans in an expert system, questions whether any *one* theory or model, in our case of instructional design, can be used to guide the actions of the learners or practitioners. In particular, how can the cognitivist paradigm guide "human teaching and learning when these activities are fundamentally context-bound, situational activities and not context-free, plan-based activities?" (p 120).

As does Donald Schon (1983), the foregoing authors draw attention to the problematic aspect of a paradigm in which plans must become situated actions when human beings are involved. Similarly, each individual in the collaborative instructional design process brings a unique biography and history to each new experience, and each interaction entails a unique, "phenomenologically and contextually-bound" process which requires sense-making. In other words, the participants in such a process act, or design, on the basis of embodied skills and understandings, or *cultural knowledge,* and not solely on the basis of rational, technical plans. Creating this social environment of reflective problem-solving situates the team at the center of a creative, dialectical process in which life experiences are integrated into the community of knowers. Elements of this knowledge community include the sharing of meanings, values, imaginations, and histories. This life-world validating discourse or practical discourse is discussion of a fairly rational kind about the validity of norms and rights, rules, and factual propositions.

THE COLLABORATIVE CULTURE

> Instruction is a human creation and the addition of technology to instruction is also a human activity. Instruction and instructional technology are human inventions that spring from human values and human designs. They are value saturated and operate in the social world quite unlike phenomena in the physical world. Social inventions such as instruction and instructional technology, both in their inception and subsequent histories, are never value-free or value-neutral. They resonate with the values of their human creators, who themselves are situated in a particular culture in a specific time and place. As the culture evolves, old social inventions may be seen as having fortuitous carryover qualities or, at the other end of the continuum, they may be seen as deeply flawed for this time

> and place. But we can only know or act on this knowledge if we engage in social interpretation and articulate a sense of professional responsibility for open-ended criticism within our own field of instructional technology.
> Johnsen & Taylor, p. 82, 1991

Although instructional technology has been considered value-neutral (Engler, 1972, cited in Taylor & Swartz, 1991), as a culture it is more accurately value-intensive in its support of a particular scientific worldview (Taylor & Swartz, 1991). Viewed as being compatible with a "static and passive curriculum that promotes the current dominant authority in society and disempowers non-dominant groups" (Taylor & Swartz, p 57, 1991), instructional technology has supported the delivery of received knowledge (Fox, 1991). In the late sixties, however, some curriculum designers had begun to challenge the emphasis on curriculum design as a set of carefully written behavioral objectives. Eisner, for one, asked whether the rational prespecification of goals had to be *de riguer* in curriculum planning, responding that"...(this assumption) is rooted in the kind of rationality that has guided much of Western technology. The means-ends model of thinking has for so long dominated our thinking that we have come to believe that not to have clearly defined purposes for our activities is to court irrationality or, at least, to be professionally irresponsible. Yet, life in classrooms, like that outside of them, is seldom neat or linear" (cited in Saettler, p 291,1990). It is our view that as teams of individuals with diverse personal and professional backgrounds come together in a collaborative design team the process of sharing and creating new knowledge and meanings must fundamentally change the perception of instructional design as a quantitative, linear, rule-based, impersonal task. In this rational view of design-as-optimization, instructional design is a formal representation of problem-solving heuristics (Tripp, 1991).

DeBloois (1982) delineates the inadequacy of current design models for interactive video:

> A model or paradigm is defined as: a standard or example for imitation or comparison; a conceptual framework or structure for action; a plan, usually represented as a graphic analog or flow chart. Cyrs (1976-77) claims we construct models in order to simulate the organization of data and phenomena in such a way that we can see the intended variables and possible influences or consequences or altering these relationships.....Following this assertion, a model must be adequately conceptualized to abstract the parts or *structural elements* as well as the *process elements* which make up the whole of the entity being analogized....However, with the pressure of recent instructional technology, it is becoming increasingly apparent that our models of the past decade no longer adequately represent either the structural or process elements of that which they are supposed to simulate, (p 31)

Since the design of an interactive videodisc requires the cooperation of individuals with diverse personal experiences, values, knowledge structures and professional backgrounds, the instructional designer must be sensitive to the meanings that are constructed collaboratively within the larger culture of the project and smaller culture of the design team. DeBloois makes reference to this aspect of culture-building in identifying *language* as an artifact of the process:

> Teams of individuals.. .must interact throughout the design and development process. Each individual member of the team must give and receive information which will result in a cohesive and polished system of instruction... .Designers must extend their ability to speak the language of the other specialities in order to gain standing with other experts on the team, (p 49)

In its conception as a systematic, ends-based process, instructional technology has supported the delivery of the fixed knowledge base of the dominant culture across time and space. Replicability and reliability issues have reflected a view that means that an instructional product, once designed, can be reproduced endlessly and used repeatedly, resulting in the same outcomes regardless of context. Taylor and Swartz (1991) ask "how will this worldview of instructional technology serve the members of an alternative knowledge community who expect people to collectively engage in the creation of knowledge? How will instructional technology respond to the requirements of fluid, multiple knowledge structures negotiated at the local level?" (p 61). In our opinion, turning the perspective around from focus-on-product to focus-on-process legitimates the artistic, constructivist nature of knowledge-building communities such as interinstitutional collaborative instructional design teams.

Collingwood (1938), cited in Davies (1991, p 98), contends that an activity has elements of art if the following distinctions are blurred or absent:

- Distinctions between planning and implementation.
- Distinctions between means and ends.
- Distinctions between raw material and finished product.
- Distinctions between form and matter.

During the collaborative design process, we found these distinctions increasingly difficult to maintain. In fact, this difficulty gave us a sense of unease in the design process because we started with an explicit commitment to a systematic design model. This sense of unease, or *cultural dissonance,* occurred as a result of the clash of the instructional design culture, and our own emerging *subculture* of teacher/educator/curriculum planners. At root, the rational, algorithmic nature of the instructional design culture clashed with the *interactional, collaborative, conversation-based* nature of teacher culture. In reflecting on our experiences and in noting Collingwood's characterization of *art* in activity, it became apparent to us that we were including elements of art in the design process.

INSTRUCTIONAL DESIGN AS ART

Briggs (1979), among others, has described the generic characteristics of a systems approach to instructional design. As noted below, each of these characteristics fails to recognize the artistry inherent in the process defined. According to Briggs (pp 5-18), an instructional design system comprises:

1) *an integrated plan of operation of all components of a system, designed to solve a problem or meet a need.*

Initially, we engaged in a variant of task analysis, during which we discussed the instructional problem, profiled the target learners, and identified project and learning objectives. However, we went beyond these rational tasks to identify and contract meta-level objectives such as *the Faculty of Education and Edmonton Public Schools will have a successful collaborative experience* that, later, we saw relating to culture-building in the blurring of means and ends. In this sense, problems and needs were always emerging, because the personal needs of the group members became important. Although we were institutionally accountable for the videodisc end product, the real question became *What are our ends?* In our case, the collaborative process was no less important than the videodisc product and became, in fact, one of the products to which we were most committed.

Working in a collaborative environment made it clear that the creation of an interactive videodisc is not done according to a formula. Rather, the nature of the form (interactive) and its function (interactive conversation in learning) shaped and was shaped by the form of the design process (collaborative conversation) and its function (to produce a videodisc on questioning strategies).

If an instructional design system assumes an integrated plan of all its subsystems, which assumes a prior agreement on means and ends, then the instructional systems design approach did not capture all of what we did. Instead, we found a blurring of means and ends that negotiated a balance between form and function. For us, this was a culture-building activity.

2) *an analysis of design components in a logical but flexible sequence, and careful coordination of the total effort among planners.*

This characteristic of an instructional design system fails to recognize the blurring of form and matter and of raw material and finished product that emerges during the process and redefines the process in action.

We are claiming that this blurring of form and matter becomes an art form in the building of a culture. For instance, it is impossible to tightly script classroom events not only because of their inherent unpredictability, but because classroom teaching is itself a culture with implicit codes and meanings that require negotiation for entry and exit. Although we all had membership in this culture, for the project duration we were not *in* the culture, and consequently needed to be sensitive to the social context. For example, non-interference in a sequence of classroom events is a tacit rule understood by the design team members, but this needed to be made explicit to those not of this sub-culture. Making such a socially-constructed rule explicit is a socialization process in culture-building.

Our vision of the finished product (i.e., the disc as embodiment of the final design) defined the raw material (the classroom teaching sequences). However, the raw material shaped the finished product, and in a recursive way was shaped by the emerging product (our design vision). We noted that in a culture, the artist likely has a version of the finished product in mind, but does not have a true vision of what it will actually look like when finished. That is, the raw material will almost always in some way shape the finished product.

3) *design procedures that are research-based, as far as is possible.*

This characteristic disregards the input of the designers and the collaborative, interactive nature of videodisc design in particular. The implication here is that the craft of instructional design is externalized, and thus accessible to anyone who wishes to develop this skill. However, in culture-building such as we are describing the design procedures are implicated in the means/ends dialectic. The intuitive, conversational aspect of collaborative design reminds us of Donald Schon's characterization of design as dialogue (1983).

4) *an evaluative component that calls for empirical testing and improvement of the total instructional plan based on tryout and revision.*

For us, the distinction between planning and implementation was blurred: Implementation was actually a design component. In addition, the physical nature of a videodisc makes it very difficult to empirically test and revise; in fact, testing an approximation of a disc (by using videotape, for instance) is problematic because the interactive, conversational nature of the process is not represented.

5) *requirements for comparison of the final version of the instruction with alternate instruction, or in the absence of an alternative, the value of the final form of the instruction is to be determined.*

This point is almost archaic in relation to electronic media, in which the learner controls the interaction in a self-conversation. Interacting with a videodisc is, in effect, the task of creating a new reality, building a different cognitive structure. It is the creation of a setting for conversation. The task of planning, therefore, becomes the task of creating a new reality, and it happens anew with each new project.

In our view, it is not always appropriate to think of *alternate modes* of instruction and is particularly inappropriate to compare a form like direct instruction to individual use of interactive videodisc. There is an assumption that an instructional task exists in some absolute educational culture, but the videodisc being integrated into the culture itself shapes the culture. *Value*, in this sense, refers to the output of identifiable, skill-based "hard skills", where in a cultural sense value refers to the "soft skills" of negotiating shared meaning, for both the designers (on a team) and the learner using the product. Soft skills includes communication, negotiation, active listening, and collaborative and individual decision-making.

In considering projects that bring inter-institutional teams together to work collaboratively, we have found it helpful to think of the team-building and instructional design process as culture-building. One indicator of culture is the creation of art forms. Based on Davies' discussion of Collingwood's distinctions, we have argued for an interpretation of our design process that features elements of art, as well as of craft and science.

PROMOTING CULTURE-BUILDING IN AN INSTRUCTIONAL DESIGN ENVIRONMENT

The creation of art forms is commonly recognized as a culture-building activity. However, there are other indicators of a culture-building process that were present in our collaborative design efforts. Among these were the use of existing tools, such as an electronic flowcharting program *(Easyflow)*, and the creation of additional artifacts as design tools, such as a database that functioned as both a videodisc planning form and scripting device. Cultures have always been characterized by their knowledge systems, of which *technology* is one. The creation of artifacts in this system contribute to a *technology of design* that is then available for use in other instructional design contexts. Artifacts can be tool-like, others carry meanings that are understood by members of the culture, such as icons; others are symbol-systems, such as specialized language. Artifacts are more than features in a "getting-things-done" environment, they are an integral part of an emergent culture. That is, knowing something about the artifact recreates a whole domain of meaning, an entree into the *sacred stories* (Crites, 1971) of instructional design. The tools become part of the solution to a problem, for example, the creation of an electronic planning form on a database. Not recognizing these artifacts as tools that are culturally-embedded leads to them being imposed on novice design team members, very often the content expert.

In addition to serving the instrumental purposes of instructional design, the creation and use of these systems perform a specialized function in culture-building, that of lubrication for the *social wheels* of the process. Encountering people who don't share these symbol systems with their attendant meanings is disconcerting and immediately identifies them as outsiders. Within the core design group this was not problematic because we had all come from teaching backgrounds. However, when the group expanded to include the production crew, a culture clash manifested itself in difficulties we had communicating our cultural knowledge of the teaching process as represented by the script/descriptions of the intended video sequences. Hence, for collaborative instructional design projects, which typically bring together a large number of people from disparate backgrounds, the use of symbol-systems within an emerging culture can be either an *inclusionary* or an *exclusionary* process for the individuals involved. In this regard, the instructional design field is no different from professions that create jargon as an exclusionary device. So, from a culture-buildingperspective, symbol-systems must be explicated as the language of the imminent culture and seen to emerge from the needs of the team.

A creative social process like collaborative instructional design can be risky, often requiring personal change (Naidu, 1988). Cultural rituals can be sources of comfort in a new and unpredictable situation, e.g. you know what to do next. In a static culture it may be the case that rituals are vestiges of earlier formal procedures that were once imbued with meaning. In the rational, algorithmic view of instructional design, legitimate procedures such as *task analysis* and *formative evaluation* may become ritualized and invoked unthinkingly: they become the sacred stories of instructional design. We suggest that in a view of design as-culture building, rituals are dependent on the shared social context for their meaning. In fact, in culture-building rituals are *created* to meet emerging needs. In our project, formalized *perception-checking* at the start of each design meeting became a ritual that bridged our worlds of teacher/educator/curriculum planners.

CONCLUSION

In this paper, we have talked about *acculturation* and *culture-building*. For us, the primary difference lies in the *intentionality* of the process. In acculturation, intentionality is easily recognized and accepted, whereas in culture-building intentionality is not necessarily apparent or expected. Although enculteration has not been discussed, there is a recognition that involvement in this collaborative project has resulted in *videodisc enculteration* for the team members. That is, there is a growing appreciation for the structure and potential uses of the technology, which was an intended goal from the beginning.

We have proposed an alternative to the view of instructional design as a rational, systematic process. Approaching the process from the perspective of culture-building provides a different lens through which to see the creative nature of the activity. Admittedly, many successful instructional products have been crafted from systematic activities based on prescriptive design models, but these processes ignore the essential humanness of the educational endeavour. In an age of increasing technological applications in education it seems important to preserve and encourage the view of human beings coming together in a creative act of culture-building. In thissense,theprocessstartsanew with each gathering. So, although we reject a top-down, hierarchical prescription for successful culture-building, that is not to say that nothing can be done. On the contrary, we believe that being conscious of the personal nature of the process will *surface* and make problematic a craft-oriented design approach. We sense that from this will emerge a more honest design that is faithful to both the original instructional problem and the individuals involved.

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The Rise and Fall of CAI at the University of Alberta's Faculty of Education

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Abstract: In 19V2, the Faculty of Education at the University of Alberta marked its fiftieth year of operation. During the middle period of these years, beginning at about 1968, the Faculty became well known for its innovative work In the use of computer assisted Instruction (CAI). This paper Identifies the antecedents of this work as the research orientation of those who brought the Faculty into existence. This orientation provided the Impetus for the development of a research laboratory which grew to eventually encompass numerical computing as well as computer assisted Instruction. Some of the factors contributing to the decline of computer assisted Instruction at the University of Alberta are also Identified.

Resume: 1992 marque le cinquantieme anniversalre de la faculte d'FJducation de I'Universited'Alberta, Des 1968, la Faculteetait reconnue pour le travail Innovateur qu'on y accomplissait dans le domaine de I'enselgnement assiste par ordinateur (Computer Assisted Instruction [CAI]). Le present expose retrace I'historique de I'orientatlon prise par ceux qui ont contribue a mettre cetteFaculte au monde. C'est cette orientation qui a favorise I'etabllssement du laboratoire de recherche qui s'est par la suite orlente vers rinformatlque numerlque et vers I'enseignement assiste par ordlnateur. Les facteurs qui ont contribue au declin de I'enseignement assiste par ordinateur a I'Unlverslte de I'Alberta sont aussl identifies.

INTRODUCTION AND ANTECEDENT DEVELOPMENTS

Although a university-based Faculty of Education did not exist in Alberta until 1942, individuals working within antecedent teacher-education institutions and programs ensured that the new faculty began with a scholarly, scientific and innovative basis both in research and in developing new methods of pedagogy. While it is rare to attribute the impetus for innovation to one individual, the direction the new faculty took was determined in large part by the first dean, M. E. LaZerte, who had been Director of the School of Education at the University of Alberta since its inception in 1929 (Chalmers, 1978). LaZerte, who obtained his doctorate in 1927, under the direction of Charles H. Judd (1873-1946) at the University of Chicago, shared Judd's views eschewing the principles of behavioristic psychology as being appropriate for the education of humans (Judd, 1932; LaZerte, 1935). In consequence, LaZerte concerned himself with the pragmatic and practical aspects of teacher education, the scholarly concerns of analyzing how students learn and which methods of instruction are most effective. In this respect, LaZerte differed from many of his colleagues at the various Normal Schools in Alberta, whose prime concern was the rapid and consistent training of teachers for Alberta schools. The tone and the direction of the new Faculty of Education were set in large part by LaZerte, nevertheless (Dunlop, 1955).

LaZerte's theory of learning is similar to one expounded by Bruner (1961) who contends that the learning of concepts and some abstract ideas entails a hierarchical progression from concrete to abstract. In respect to learning the basic concepts of arithmetic, for example, LaZerte (1922) states,

> Before the child has experienced the need for a number, before he has used it, talked it and lived a little of it, we introduce him to a set of number symbols. A deadening process begins at once. Instead of thinking number the child tries to think in symbols; THREE now ceases to be a number idea and becomes that peculiar twisted mark, 3. (p. 30)

The use of instructional devices as aids to both teaching and learning were considered by LaZerte to be an essential element of effective instruction, therefore. Throughout his career, he both designed instructional aids and encouraged their use by students in the Faculty.

As part of his research analyzing student learning, begun in the 1920s, LaZerte developed several devices and methods to minimize instructor/tester involvement, so as to increase the likelihood of gathering data in a consistent manner. At the same time, LaZerte also discovered that some students learn new information by interacting with these devices. This discovery was important, since it provided a means by which LaZerte could address a perceived need in instruction within many schools. Before the 1950s, much rural education in Western Canada took place in one or two-room schools, where one teacher was responsible for teaching several grades simultaneously. Devices that could provide instruction without constant supervision by a teacher, could improve the instruction offered in such schools. LaZerte's discovery prompted him to develop, by 1929, a mechanical device called *the problem cylinder,* that could present a problem to a student and accept responses to ascertain whether or not the student's solution steps were correct. The problem cylinder and some of LaZerte's other instructional devices are described elsewhere (LaZerte, 1933; Buck, 1989). Although isolated individuals such as Sidney Pressey of the Ohio State University had developed similar mechanical teaching machines a few years earlier, LaZerte's efforts are described both as pioneering and comprising the spirit of innovation underlying the new Faculty of Education at the University of Alberta (Dunlop, 1955).

Developments following LaZerte

LaZerte's interest in developing and encouraging better methods both in research and teaching, led to the eventual introduction of mechanical and electromechanical apparatus to assist with the analysis of research data. This apparatus consisted primarily of tabulators and calculators. They were used to calculate statistics, so as to demonstrate the variability in achievement among students in Alberta schools. After LaZerte as Dean in 1950, other individuals within the Faculty of Education who shared LaZerte's concerns and aspirations, sustained the direction and research emphases he established. One such individual was G. Murray Dunlop, a Normal School veteran and, eventually, the first head of the Department of Educational Psychology.

Dunlop (1954) states that many research projects undertaken by both faculty and students were frequently hampered, or their usefulness diminished, through "the shortage of mechanical aids which take the drudgery out of the undertaking" (p. 21). In 1953, the newly-formed Faculty of Education Research Committee, through discussions with the Alberta Department of Education (now referred to as Alberta Education) began to upgrade the quantity and the quality of research equipment available to the Faculty of Education. Dunlop (1954) reports, "We have every assurance that the Provincial Government will permit the use of their I.B.M. machines [likely mechanical keypunching and/or card-sorting machines] when not otherwise required... A proper supply of computing machines and other mechanical equipment can be acquired over the years" (p. 25).

Although computers were being used at some universities for research purposes by the mid 1950s (Augarten, 1984), few were being used in Faculties of Education. Besides the scarcity and expense of such equipment, operation of these early computers required individuals possessing specialized skills in subjects such as programming and electronics, skills not usually possessed by educators at that time. It is not surprising, therefore, that a computer was not purchased for or by the Faculty of Education for several years. Dunlop (1956) notes that such purchases, "must be left to the future... At present we have access to such equipment as the university owns, and, by arrangement, may use the equipment of the departments of Education and Municipal Affairs" (p. 76).

While it appears that Dunlop appreciated the potential uses of computers in education, he did not possess much knowledge of them, nor did most members of the Faculty of Education at that time. Interest shown in computers by graduate students was encouraged, however. In the late 1950s, for example, a graduate student, Stephen Hunka, expressed interest in performing statistical calculations using a computer. While the Faculty did not possess either the required equipment or knowledge, Dr. R. MacArthur of the Department of Educational Psychology enabled Hunka to use a Royal McBee model LGP-30 minicomputer located in the Department of Physics. Hunka demonstrated that it was both possible and efficient to use a computer to calculate means, standard deviations, and correlation coefficients. This exercise also showed how the Faculty of Education could benefit through cooperating with other departments and faculties. No further applications were made of this computer since there were no computer programming languages available, such as Basic or Fortran, to permit easy development of programs. In subsequent years, following the development of computer technology, members of the Faculty of Education began to use and acquire computers both for research and instructional purposes.

To be sure, the economic growth of the early 1960s contributed to the ability of the Faculty to obtain computing equipment. Another factor leading to the Faculty of Education's eventual acquisition of computing equipment, was the progressive attitude and supporting actions of the University's president of the time, Walter H. Johns. A subsequent President, Harry Gunning (1974) states, "Under the dynamic leadership of Walter Johns, this University gradually emerged from the chrysalis of parochialism into a fully developed centre for creative education" (p. 3).

Teaching Machines and Programmed Instruction

While interest in adapting computers for uses in education developed among some members of the Faculty of Education, another group was developing interest in the largely American phenomenon, rising from Skinnerian behaviorism, of using teaching machines and *programmed instruction* (PI) methods as the primary means of instruction in primary, secondary and post-secondary classes. In spite of being interested, most faculty were reluctant to join the bandwagon advocating a wholesale adoption of PI and teaching machines. The slowness with which teaching machines and PI were investigated at the University of Alberta was due in part to prudent caution. Many teaching machines and much programmed instructional material were not readily available in Canada for several years following the initial surge in interest shown in the United States (Rutherford, 1961; Sorestad, 1963).

Several experimental uses of teaching machines and PI methods were undertaken by staff of the Faculty of Education. Rutherford (1961) reports that some individuals were, "preparing a program in statistics but little progress yet; has bought two programs and planning to buy two machines" (p. 116). Some work was done evidently, since a Rheem-Califone model 501 *Didak* teaching machine, designed by B. F. Skinner, containing the remnants of an introductory lesson in statistics has survived.

Clarke (1961) likely reflecting the enthusiasm of educators subscribing to the teaching machine bandwagon, predicted that teaching machines would become an integral part of most classrooms, and that "one prediction is safe: they [teaching machines] will be present in classrooms within ten years" (p. 72). In spite of this prediction, it does not seem that the teaching machine(s) used in the Faculty of Education operated in the manner anticipated, since use was soon discontinued and no further research with teaching machines is reported. This point is corroborated by J. D. Ayres, a professor emeritus of the Department of Educational Psychology, who states, "I did not consider teaching machines, which were really very primitive, and not much more advanced than Babbage's 1800's computers, a suitable vehicle for research" (personal correspondence, December 5, 1988).

Other individuals within the Faculty seem to have conducted some research with teaching machines, but no evidence has been located to suggest that prolonged or extensive instructional use was made of teaching machines. While many initiatives using PI techniques were developed and used by faculty members, a greater impact and innovation was the more widespread and varied use of computers by the Faculty during the 1960s and 1970s.

COMPUTERS FOR EDUCATIONAL RESEARCH

General Research Applications

By 1960, spearheaded by the need for research as part of the development of a doctoral program supported by the Carnegie Foundation, the Faculty had established a research laboratory for the processing of numerical data primarily from surveys and achievement testing. A major goal of this laboratory was to demonstrate the wide variability in achievement within given grade levels of Alberta schools. As noted previously, ready-made computer programs were essentially non-existent, so the Faculty had little choice but to use unit record equipment and electro-mechanical calculators. The unit record equipment consisted of an IBM card sorter-counter and a keypunching machine. Calculators were still required, since the card-sorter could perform no arithmetic operations other than counting. It was Dunlop's plan that the research laboratory would perform a valuable service both to the Faculty and to the field in the analysis of data, and that this service would provide some of its financial support.

By 1961 the University of Alberta had acquired an IBM 1620, a small mainframe computer system, and shortly thereafter an IBM 7040 system. The processing of research data became more routine, especially for the more numerically inclined graduate students. With the move of the Faculty of Education from the old Normal School building (now called Corbett Hall) to the new Education Building in 1963, the research laboratory was expanded, and additional equipment for data analysis was obtained.

With the rapid growth of interest in research, particularly in the general area of measurement and evaluation, the Division of Educational Research Services (DERS) was formed in 1967, and equipment was consolidated under its jurisdiction. The DERS acquired the University's first electronic optical examination scoring machine, as well as the first IBM magnetic tape typewriter for the production of research manuscripts authored by faculty members. Also in 1967, the University acquired an IBM 360/67 computer system, access to which enabled DERS to prepare a package of computer programs for statistical analysis which were extensively used on campus and also distributed to other universities. A remote computer terminal located in the Faculty also permitted the use of Iverson's APL language for data analyses (Iverson, 1962). During the next few years, research demands of the Faculty used about 10% of the University's computing resources each year, with so many jobs being processed that the University's first delivery service of computer input and output was established in the Faculty of Education on a six days per week schedule. To provide some students in public schools an opportunity to use computers as adjuncts to classroom instruction, four remote printing terminals connected by telephone modems to the IBM 360/67 and accessing APL, were placed into an elementary, a junior high school, and two senior high schools in the Edmonton area. By sharing a common file accessed by both high schools, the students developed a simple system of electronic-mail.

INSTRUCTIONAL USES

Training Computer

The first purchase and use of a computer for instructional purposes specifically by the Faculty of Education, appears to have been made by the now dismembered Department of Industrial and Vocational Education. Under the direction of H. R. Ziel, a Fabritek transistorized training computer was purchased in 1965, as an instructional adjunct to the electronics courses offered to students intending to become industrial arts teachers. The unit, which occupied most of the surface of a sturdy table or large desk, was designed so that component panels inside the cabinet could be withdrawn for maintenance and to facilitate the observing of discrete parts of the system such as the core memory and the resistor-transistor logic gates. Input to the computer could be achieved either by pressing illuminated switches on the front of the cabinet, or by means of a two<ligit octal keyboard, connected to the computer by a length of cable. Although only simple arithmetic operations could be carried out by this computer, it did function according to the same principles of operation as larger computers of the day designed for other purposes. While the newer computer technology of the 1970s made the Fabritek computer obsolete as an instructional device for illustrating current computer technology, it continued to be used until 1987 to show some examples of early computer technology. Although replaced by the Department of Adult, Career and Technology Education, the old Department of Industrial and Vocational Education was at the forefront in other areas of using computers for instructional purposes.

DECPDPs

By the time the Department of Industrial and Vocational Education had ordered the Fabritek unit, minicomputers were beginning to be marketed. Two standard model PDP-8s were purchased in 1967 (personal communication with Dr. M. Petruk, February 1992). The standard PDP-8s use toggle switches rather than a keyboard to enter data. Although intended primarily for instructional purposes, the DEC minicomputers were not designed for presenting instruction, so they did not possess a user-friendly interface and were not used as extensively for instruction as some other computer systems designed subsequently. The DEC minicomputers continued to be used for instructing programming skills until the purchase of microcomputers in the late 1970s. For teaching programming skills and techniques, and for the development of experimental instructional paradigms, the department purchased a Digital Equipment Corporation model PDP-8 Classic minicomputer in 1975. This unit, about the size of a small desk, contained an integral keyboard, an 8.5 inch floppy disk drive and a small monochrome monitor.

APL

Although most of the computer applications of the late 1950s and the early 1960s were of a numerical nature, interest in using computers for instructional applications was growing. Because APL is an interactive language, the potential existed to use computers for interactive exploration of mathematical concepts and direct instructional functions. The first CAI application, made in 1967, was an arithmetic drill program. This program automatically adjusted its level of difficulty as a function of the student's rate of success.

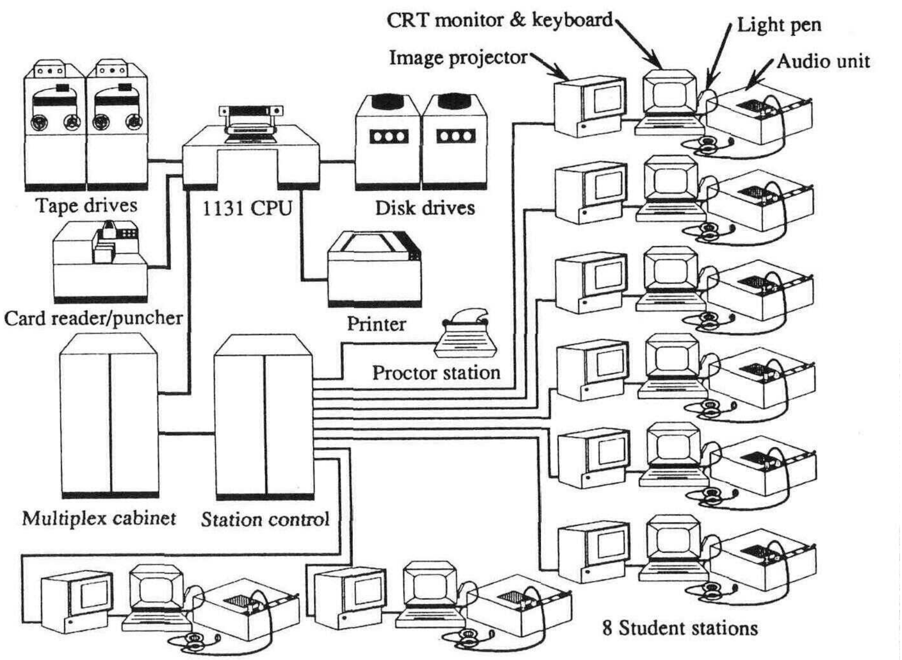
In cooperation with J.A.L. Gilbert in the Faculty of Medicine, an interactive simulation of the management of a medical patient with hypertension was created using APL, as a basis for the development of more valid medical examination procedures. The approach kept the logic of the simulation distinct from the medical content, and foreshadowed the development, within the Faculty, of VAULT (a Versatile Authoring Language for Teachers) by Romaniuk (1970). VAULT allows teachers to use pre-defined models of instructional logic for their own specific subject matter needs. APL had also been used earlier by Romaniuk for the development of an interactive vocational guidance program. Thus, through the use of the interactive APL language designed for numerical applications, the Faculty and campus were introduced to what is known today as computer-assisted instruction (CAI).

IBM 1500 System

In 1968 the Faculty in cooperation with the Department of Computing Science, received an IBM 1500 CAI system, initially prototyped at Brentwood school in California by Patrick Suppes of Stanford University. Shortly thereafter, the Donner Foundation (Canada) through a grant of $52,000, supported graduate students interested in researching the use and effectiveness of CAI. While other CAI programs were started at about the same time at other universities in Canada, most were largely experimental, and none used an integrated computer system designed specifically for providing instruction. Although the Quebec Ministry of Education was the only other Canadian organization to obtain an IBM 1500 system, it was a short-lived installation. The University of Alberta's installation survived as the only such system in Canada, and one of the longest-lived IBM 1500 systems in North America.

The IBM 1500 system was the first fully integrated instructional multi-media system (graphics, sound, and single-frame 16mm film projection) supplied by a single manufacturer. Its initial configuration at the University of Alberta consisted of eight student stations each having a monochrome CRT display with keyboard accessing different font sets, a light pen, a magnetic tape-based audio system (record and play), and a rear screen projection system. The IBM 1500 system has received little formal documentation in the research literature, and most employees of IBM hardly know that it ever existed, since only about 25 such systems were produced. Figure 1 illustrates the basic components of a 1500 system and their functional relationships.

Figure 1.
Typical Configuration of an IBM 1500 System.



The CPU was an IBM 1131 processor with 64K of memory, which in comparison with today's microcomputers would hardly qualify as being useful at all. Through system software, the CPU operated in a time-sharing mode. System software was stored on a 250K disk drive located with the CPU. Four additional disk drives of 250K each were configured to hold the courseware code. Since only one copy of courseware existed on the system, the location of the course code to be executed for each student had to be maintained. In addition to the CPU being used for execution of course code, it also controlled the film projection and audio system for each student station. Information resulting from the execution of a specific sequence of courseware for a given student was written to a large video buffer which continuously refreshed the appropriate screen display. This method of maintaining the screen displays for each student, because of the high volume of information being transmitted, required coaxial cables and prohibited the location of student stations at more than about 1,000 feet from the CPU. As with any small CPU used in a time-sharing mode, poor programming techniques could cause unacceptable response time delays for all students. To appreciate the quality of the software design of the system, one only needs to consider that in spite of the diminutive size of its CPU (compared with the capacity of current microcomputers) the IBM 1500 system could control up to 96 peripheral devices, that is, 32 stations multiplied by 3 for control of the primary student station, audio, and the projection system. The magnetic tape drive system was used for storage of performance records and graphics information, which was required to produce hard copy documentation. The documentation of graphics was done through the University's Calcomp plotter, located at the University's Computing Center.

Of course, hardware alone does not make a CAT system. Effective procedures for the creation of courseware, its execution, and support services for the instructor are also required. The authoring language used was COURSE-WRITER II, supplied by IBM, which had a command syntax requiring the definition of numerous parameters. COURSEWRITERII was executed through an interpreter rather than a compiler. It was soon learned that CAI computation was quite different than numerical computation, especially in determining whether a CAI program ran correctly. To facilitate determining the technical correctness of courseware, a list processor using Fortran was developed, into which the course logic was automatically abstracted and then traced to identify logical inadequacies, infinite loops for example (Flathman,1969). The software could also simulate students using the courseware, with various probabilities being assignable to different response categories. Other early uses of the system included: administration of individual intelligence tests (adaptive testing), Boyle (1973); examination of the relationship between intelligence and achievement using CAI (Brown, 1969); the development of an interrogative authoring system (Paloian, 1971). In anticipation of studying eye movements by students using CAI, Petruk (1973) designed and built a computer controlled oculometer system, likely the first such system ever developed in Canada.

The instructional operating environment of the IBM 1500 system provided many features required of an instructional environment, such as a registration system for authors, proctors, and students, provisions for restarting the course at an appropriate location for each student, authoring support services, and progress reports. Although more powerful systems exist in todays microcomputers, operating in a stand-alone mode or on a local area network (LAN), these do not provide necessarily for the instructional operating systems requirements of CAI.

The IBM 1500 system in the Faculty was rapidly expanded to 16 terminals, and eventually reached a configuration of 23 terminals. The academic and technical staff of the CAI facility participated actively in the IBM 1500 Users Group, which eventually became known as the Association for the Development of Computer-based Instructional Systems (ADCIS) which currently publishes the *Journal of Computer-Eased Instruction.* CAI programs as well as specialized functions developed in support of the instructional courseware were shared with members of the IBM Users Group. A particularly important development, facilitating the interactive creation of graphics using the light pen instead of specifying graphics on punch cards, was designed by N. Margolus (then an undergraduate student working part-time for the CAI facility and who later was to graduate with a Ph.D. in computational physics from M.I.T.) and N. McGinnis.

An unusual characteristic associated with the operation of the CAI facility from its inception, was that graduate students from fields other than education became involved either as students in the Faculty of Education, or as students of other Faculties. Together with graduate students in Educational Psychology, graduate students trained in other fields provided a truly interdisciplinary approach to CAI research within the Faculty of Education.

Uses and Further developments of the System

By the middle 1970s, the Faculty of Education was well on its way to making extensive applications of computers both for numerical and instructional processes. In one form or another, it had explored avenues of computation which foreshadowed many more recent developments. For example, some of the firsts included the creation and use of statistical program packages before commercial packages such as SPSS were developed, test scoring and item analysis, remote access to computers via telephone lines, interactive computing, e-mail, educational uses of computers in the areas of instruction, testing, and simulations, and the study of eye movements as it relates to learning. At least one graduate student, in a rather unofficial manner, used the IBM 1500 system's capability for handling text to produce a thesis, thus anticipating the local use of computers as word processors.

In addition to the Faculty of Education, the IBM 1500 CAI system was used by other Faculties at the University of Alberta. Although the Faculty of Education was the largest user, the Faculty of Medicine made extensive use of the system by scheduling all its second year students (108 students) for a CAI course in cardiology developed by R. E. Rossall of that Faculty. Today, this course is the only currently operational CAI course originally developed on the IBM 1500, transferred to the University's PLATO installation, and then to IBM PCs using the Infowindow system and videodiscs. This course, which today has been operational for over twenty years, is likely to be recognized as possessing the longest continuous history of operation of any CAI course. The Faculty of Medicine also developed many patient management problem simulations for its own use, and for use by the Royal College of Physicians and Surgeons of Canada. Individuals in other areas of medicine such as anassthesiology, and individuals in areas related to medicine, including pharmacology, microbiology, nursing, and obstetrics also developed CAI courseware on the Faculty of Education's IBM 1500 system. The work of the Faculty of Medicine attracted considerable interest worldwide, attracting visitors from over 20 countries, including a visit from a Chinese medical delegation which made a special trip to the University of Alberta after their tour of the United States.

The initial use of the CAI system by the Faculty of Education was for teaching an introductory statistics course for graduate students, written by three staff members in the Department of Educational Psychology. This course was newly developed, and was not a transcription of the course designed for the Didak teaching machine. In this instance, the CAI system comprised the primary source for most of the instruction for the course. Eventually, the course grew to provide about 90 hours of instruction, and was used for over ten years on the IBM 1500 system, after which time it was converted for operation for another six years on a Digital Equipment VAX system. In cooperation with Pennsylvania State University, a special education course named "CARE", developed by P. Cartwright, was made available in the Faculty. A course in electrical theory, initially obtained from the U.S. Signal Corps at Fort Monmouth, New Jersey, was revised and extended to include a mathematics component, and made available to classes in the Department of Industrial and Vocational Education as well as to electrical apprenticeship students at the Northern Alberta Institute of Technology. The course included a practical laboratory component, for which the responses to the assignments were checked by the CAI system. At the time the 1500 system was decommissioned and returned to IBM in 1980, the system was providing about 27,000 student hours of instruction annually, calculated on the basis of actual time logged by students. Over the 12 years of operation, courses were developed in the following areas: introduction to COURSEWRITER II (the programming language of the CAI system); introduction to the use of APL using learner control; measurement for elementary school children at the Alberta School for the Deaf; introduction to beginning reading for kindergarten children; introductory French; introduction to IBM 360 (for students at the Northern Alberta Institute of Technology); Accident Reporting (Edmonton City Police Department); introductory statistics in Educational Psychology; fundamentals of data processing (for Library Science); and micro and macro economics (for the Department of Educational Administration).

The work of the Faculty in CAI was featured in a video series produced by the London Life Insurance Company, titled The Human Journey, broadcast nationally in 1973, as well as in an IBM advertisement in *Time* magazine. A close liaison with practicing teachers and the classroom was maintained by permitting students from local schools to visit the IBM 1500 system and to learn from it. Over 2,000 children per year visited the CAI installation. In addition, elementary and junior high students participating in a special program for gifted students operated by the public school system made use of the Faculty's CAI facility. Visitors from outside the University of Alberta, interested in exploring the use of CAI applications, were also accommodated. Representative examples include instructors from the Canadian Armed Forces, instructors from various technical schools, and academic staff from universities in the U.S.A., United Kingdom, Germany, China, Cuba, and Australia. The success of the CAI operations was such that demand for time on it increased. In response, the system was operated ten hours per day Monday to Friday, eight hours on Saturday, and four hours on Sunday.

During the late 1970s, budget cuts began to jeopardize the operation of the CAT facility. Fortunately, IBM agreed to grant the use of some student stations without charge. The Faculty of Medicine, through efforts of Dean W. MacKenzie and R. E. Rossall, also contributed some financial support. Additional hardware in the form of surplus equipment and cables, was obtained from the Pennsylvania State University following the closure of their IBM 1500 facility as the result of budget cuts at that university.

CDC PLATO/DEC VAX 11-785

In 1978 IBM gave notice that it would withdraw the 1500 system, despite having pressure placed on that company by a number of users, including the University of Alberta, at a meeting with IBM officials at the Pentagon in Washington, D.C. Although the option existed to purchase the system, there was no assurance that spare and replacement parts would be available from IBM. The University, especially through Computing Services, sought a replacement system to accommodate the considerable amount of courseware that had been developed for the IBM 1500 system. In 1980, the final solution was to acquire a Control Data Corporation PLATO system (a commercial variant of the PLATO system developed by D. Bitzer at the University of Illinois) for campus-wide use. The Faculty of Education was provided with funds to purchase a Digital Equipment Corporation VAX 11/785 system. Some courses from the IBM 1500 system were rewritten by the staff of the University of Alberta's Computing Services, to function on PLATO. The funds from the operation of the IBM 1500 system, which were transferred from the Faculty to the Computing Center for support of PLATO, and the commensurate loss of technical support, prevented DERS from employing the same technique of transferring courses from the IBM 1500 system to the VAX 11/785 system. Because of this, a decision was made to develop a new computing language called Elf (Davis, 1989) which would be used to develop authoring languages (by first developing the interpreters for these languages) so that program code from the IBM 1500 system could be run directly on the VAX system.

The transfer of courseware to the VAX 11/785 system allowed for some enhancements of the courseware, since the new system had terminals consisting of the DEC Gigi microprocessor as well as color display monitors. The Elf language was used to create a COURSEWRITERII interpreter. However, no equipment was available for accommodating the 16mm projection and sound system used by the 1500 system. Drawings previously on 16mm film were converted to digital form by developing an interactive graphics interpreter using Elf, specifically for handling the conversion task, as over 350 drawings were required for the statistics course. By 1981, the statistics course was operational on the VAX system. Since Keyano College in Fort McMurray, Alberta, also had an identical computer system configuration, the statistics course was used there during 1988 to provide instruction to students unable to attend the University of

Alberta. Thus, distance education was instituted using the computer installation at Keyano College, although insufficient funds precluded the establishment of computer-to-computer communication. Further developments entailed refinements to the instructional environment of the VAX. Changes included an enhanced system of student registration which also contained specifications as to how modules of the course were to be sequenced for each student, a facility to report examination marks for students and instructors, and an interactive authoring system, the development of which was supported by a grant from Social Sciences and Humanities Research Council (Hunka, 1988). By using the interactive authoring system, which included a graphics component, a 19 hour matrix algebra course was developed. The interactive authoring system used a menu of commands rather than icons found in some later operating systems and authoring programs, but it did allow for advanced features such as the definition of instructional model sequences which, once defined, would interrogate the author for input, and a simple visual representation of the course logic would be created.

Changes in Direction

By the late 1970s, the rapid development of microcomputers was evident and departments within the faculty began to use microcomputers rather than minicomputers and mainframes. In 1978, through the impetus of H. Ziel and M. Petruk, the Department of Industrial and Vocational Education became the first in the Faculty to purchase microcomputers for instructional use. Three models were obtained initially, a Compucolor, a Commodore and an Imsai. The Compucolor and the Commodore both possessed keyboards for data entry, and cassette tape drives for storage. Only the Compucolor could display colour images.

At first, the three initial microcomputers were used to teach programming in BASIC. Later, using the BASIC language, undergraduate and graduate students in Industrial Arts programs designed simple CAI programs for these microcomputers. The CAI lessons were administered to two classes of local junior high school pupils who came to the Faculty of Education's Industrial Arts laboratories twice a week for instruction. The apparent success of these three microcomputers in providing instruction led to the purchase, in 1980, of 15 Commodore PET microcomputers as well as a number of Radio Shack TRS-80s, Texas Instruments and Cromenco microcomputers. Subsequent acquisitions, largely the result of efforts by M. Petruk, included 40 Commodore Super PETs in 1981, 40 Monroe-Litton microcomputers in 1982, as well as the first appearance of Apple microcomputers in the Faculty in the form of 36 Apple 11+ models (personal communication with Dr. M. Petruk, February 1992). The lead established by the Department of Industrial and Vocational Education, and the demonstrated success of the microcomputer as an instructional device, contributed to acquisition of microcomputers by other departments in the Faculty.

In 1980, through the efforts primarily of E. W. Romaniuk, several Radio Shack model TRS-80s were purchased. These machines were used to develop an extensive arithmetic drill program which was distributed to Alberta schools via tape cassettes. Other departments in the Faculty soon followed suit by acquiring numbers of several types of microcomputers. During this period, there was not only an infusion of new computing equipment, but a rapid growth in the variety of computing. By 1981 two academic staff members had been able to acquire over two million dollars worth of computing equipment for the Faculty of Education, with the help of the Provincial Government's matching grant program and without impinging on the Faculty's capital allocations from central University sources.

With microcomputers providing access to a very wide range of applications, most of which were not of a CAT nature, the interest of faculty in large part shifted away from CAI to using computers for other functions, such as word processing, spreadsheets, instruction in simple graphics and page-layout packages, and teaching of simple programming languages like BASIC and LOGO.

To be sure, individuals within some of the Faculty's departments had been working with common audiovisual technologies while others were working with the Faculty's computer systems. Such technologies included: television, radio, film formats, overhead projection equipment, photographic apparatus and recorded sound. Instruction is still provided to students in the theories and methods of using such apparatus in schools, however, major implementations of the methods tend to be most prevalent in the audiovisual courses themselves. Elements of instructional technology e.g., computer managed learning and testing, were, nevertheless, incorporated into audiovisual developments by members of the Faculty of Education using PLATO and microcomputers.

IBM Microcomputer Project

Although IBM's support of the 1500 CAI system was terminated by 1980, that company's interest in educational applications of computers had not. Directed by M. Petruk of the Department of Industrial and Vocational Education, a collaborative project was instigated with IBM, with funding coming largely from IBM. A special microcomputer laboratory was constructed containing 27 IBM model XT microcomputers with monochrome displays and two 5.25 inch floppy diskette drives each. No hard drives were supplied initially, but hard disks and a local area network file server were added later. The laboratory subsequently came under full control of the Faculty of Education, and the original equipment has been replaced with IBM PS2/55 microcomputers, using Faculty of Education funds. The IBM microcomputer project also included the equipping of six other laboratories containing a total of 125 additional microcomputers. These laboratories are located at: Harry Ainlay High School, Edmonton; University Elementary School, Calgary; Gilbert Paterson Junior High School, Lethbridge; Province of Alberta, Department of Agriculture; and the Department of Mechanical Engineering in the University of Alberta (personal communication with Dr. M. Petruk, February 1992).

Recent Developments

With little support by faculty and administration for the work being done on the VAX CAI system, both the system and DERS were quietly shut down in 1989, and two system development programmers, who started with the IBM 1500 system, were released because of budget cuts. After 21 years of operation, the centre of control for instructional computing was shifted from academic staff and turned over to the Instructional Technology Centre (ITC) by the administration of the Faculty of Education. Although some departments within the Faculty contain small microcomputer laboratories, such as one located in the Department of Adult, Career and Technology Education, budget priorities and limits have so far prevented such facilities from becoming as extensive and research-oriented as earlier endeavors. It is hoped by some individuals, that by combining the audiovisual skills of the educational technology staff with the expertise of those staff working with microcomputers, pioneering results can be obtained in the areas of multimedia presentation and other alternate instructional delivery systems.

Using the facilities operated by ITC, two CAI courses at the undergraduate level are run in the IBM laboratory. One course is an extensive special education course developed by P. Cartwright of the Pennsylvania State University. With the assistance of personnel of the ITC, two additional modules authored by G. Kysela of the Department of Educational Psychology at the University of Alberta have been added to this course. The second course, developed entirely by faculty and ITC staff, takes an average of about 40 hours to complete, and is in the area of developmental psychology. One lecture/laboratory-based undergraduate course, an introduction to computer assisted instruction, is operated by the Department of Educational Psychology using a Macintosh laboratory equipped and operated by the ITC. Courses introducing novices to microcomputer uses in education are offered by the Department of Adult, Career and Technology Education (ACTE), and in the 1991-92 academic term this Department initiated a graduate program in the area of computer-based instruction. The graduate courses presently use the facilities operated by ITC, although it is anticipated that when funding for additional computers is provided, ACTE will be able to use their own computer laboratory for instruction and research purposes.

Through a contract with the Department of Education and the Apple Innovation Support Centre (under the directorship of M. Petruk) Petruk and his staff have completed the development of a CAI course covering the Grade XII Mathematics 30 curriculum as used by the Correspondence Branch of Alberta Education. This course, prepared using Authorware Professional, and distributed as a CD-ROM suitable for Macintosh microcomputers, is currently being field tested in some Alberta high schools for possible general use. Plans are also underway to broaden its use into Saskatchewan and Manitoba. Resident visitors to the Apple Innovation Centre, housed within the Faculty, have access to the Centre's advanced microcomputer and video equipment for courseware development congruent with its goals.

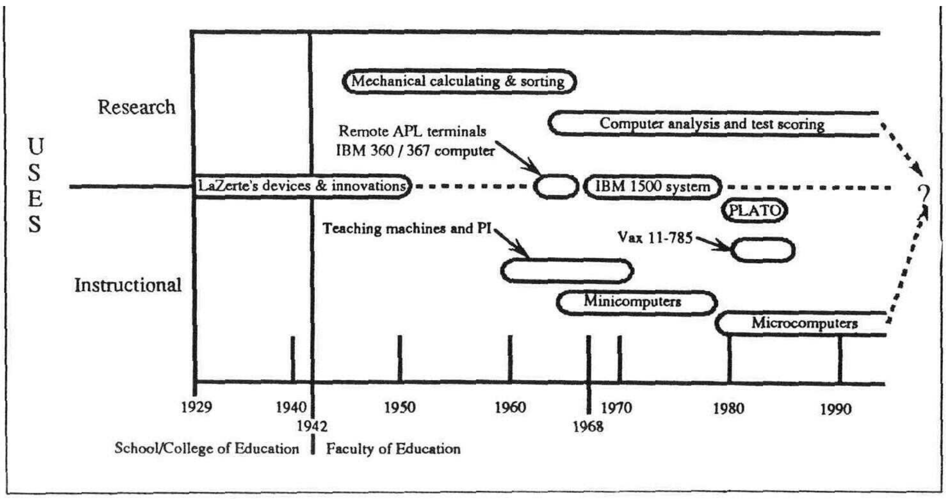
With the excellent technical expertise and TV experience resident among the professional, but non-teaching staff in the Instructional Technology Centre, tremendous strides are expected to be made in the development of CAI courseware and in the melding of audio visual capabilities with those of the computer to bring the Faculty to a new level in the use of computer technology for instruction.

SUMMARY AND CONCLUSIONS

We have examined the development of computer assisted instruction in the context of the prominence given research at the time the Faculty of Education was formed fifty years ago. The emphasis on research is identified as the basis for the initial development of a research laboratory concerned with statistical analysis primarily. Hardware advances led to the incorporation of unit record equipment initially, then calculators and finally computers. Computer assisted instruction, rather than being developed from an interest in teaching machines and programmed instruction, was found to be a spin-off of the use of computers for statistical computations. The decline of CAI as a primary source of instruction began with the introduction of microcomputers, and budget restrictions, which eventually led to a loss of support from administration and faculty for the CAI facility and to lesser extent the use of computers for statistical computations. The following chart is included to assist the reader's comprehension of the chronology and association of events and developments.

The arguments of a better quality of instruction at lower cost being provided by CAI have faded away in light of the current protracted period of economic

Figure 2.
Chronological Chart of Events and Developments.



decline and restraint. Perhaps if accurate accounting systems existed it would be found that graduate students and sessional instructors can provide instruction at far less cost than that required for the development of courseware, and the capitalization and maintenance of *a* computing facility. It will remain to be seen what effects hybrid instructional delivery systems will bring to the next fifty years of the University of Alberta's Faculty of Education.

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Book Reviews

Mary Kennedy, Editor

Empowering Networks: Computer Conferencing in Education **by** Michael D. Waggoner (Ed.)- Englewood Cliffs, NJ: Educational Technology Publications, 1992. ISBN 0-87778-238-5 (CDN $42.00)

Reviewed by Zopito A. Marini

Computer technology has made it possible to reduce the once-imposing barrier of physical distance between people to the point where it is no longer a factor in the exchange of information. Interestingly, while it has empowered people by reducing the obstacles associated with great physical distance, computer conferencing has also generated the potential to dis-empower people by creating other types of obstacles related to psychological and social distance.

Empowering Networks contains 8 chapters, each describing a computer conferencing project aimed at facilitating the educational process over varying distances. Most of the chapters use a case study approach to their presentations by including background information on the project, a nuts-and-bolts description of the hardware and software used, and an evaluation of the project. These chapters provide a panoramic view of the possible uses of the computer conferencing technology. There are two additional chapters which are meant to provide an opportunity to reflect on computer conferencing. For example, the commentary by Donald P. McNeil, in the second-last chapter, describes the danger of over-optimism and identifies the possible failings of the technology. The last chapter, by Thomas J. Switzer, contains a well-thought-out prescription for making this technology work.

The strength of the book lies in the diversity of the projects presented, which is evident in the varying degrees of sophistication of the applications, as well as of the range of physical distance bridged between people. The reader is provided with descriptions of rich and diverse computer conferencing environments; and, for the most part, the presentations are sufficiently detailed to provide enough information to assess the merits of the project, or even to duplicate it.

Although I believe that it has considerable merit, this book has two major shortcomings; one is the lack of consideration given to theoretical issues and the other is the lack of connecting links across the various projects. In regard to this last issue, it is rather ironic that, while it can be considered a strength, the dimension of diversity can also represent a weakness, particularly in the way it is handled in this book. A case in point are the last two chapters, which could have been used to provide these links. Both reflect on the technology in such a general way that they appear not to be grounded to any great extent in the projects described. Whereas it might have been the case that it was difficult for McNeil and Witzer to have access to a draft of the 8 chapters before writing their own, I believe that the text would have benefited immensely from a reflection grounded in the actual projects presented in the book. The reader would have profited from a discussion linking all the projects together by examining the similarities shared by them, as well as any differences.

As for the other shortcoming, the book reveals a general lack of recognition of the important role which should be accorded to the use of theoretical frameworks. As stated by Marini, Mitterer and Powell (1991, *CJEC, Vol. 20,* pg. 171-187), the importance of adopting, or at least beginning to adopt, a theoretical disposition in the application of computer technology is critical for the future development of the field. Computer technology will not provide the answer to educational problems if we cannot define those problems in precise terms. Until there are more robust attempts to use relevant theories from disciplines such as psychology, sociology, and computer science, the application of computer technology to education will not get past the case study approach.

While a case study may be a good starting point, in order to advance research in this area (which is one of the stated objectives of this book) a more concerted effort has to be made to use approaches and procedures which are driven from the "top-down". It is only then that the field can move from a descriptive to a prescriptive phase. I would also suggest that, unless we get to this stage of development, we are bound to be "wildly optimistic" and possibly "wildly wrong" about the future applications of computer technology.

Consider, for example, one common observation related to a number of projects. Namely, that unless the technology is easy to use there is resistance from the users in implementing computer conferencing. This may indeed come as a surprise to computer "technicians", but it is not at all surprising if we look at the literature on risk-taking. Whether we like it or not, for most people using a computer for the first time is a risky enterprise, with all that it entails. For a novice, there is potential loss of control over the work environment; self-esteem could suffer; and there are a host of other negative aspects related to poor interaction with a computer. This is what I mean by psychological and social barriers. The field has succeeded in removing the barrier of physical distance, however, we have a long way to go to reduce psychological and social distance between people and technology. If it is to improve the educational process, computer conferencing must empower users not just in the dimension of physical distance, but also in other dimensions.

Even though it has some shortcomings, this book is worth- while for the reader who is looking for some good suggestions for developing a successful computer conferencing application, as well as some very good descriptions of a number of actual, implemented projects.

REVIEWER

Zopito A. Marini is an Associate Professor and Director of the Child Studies Program at Brock University, St. Catharines, Ontario.

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