

Pan-Canadian Research Options: New Information Technologies and Learning

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Executive Summary

New information technologies are heralded as having the potential to restructure education for the future. At the same time, research in education is influencing how we think about learning and stressing the use of active involvement and collaborative group work in the process of knowledge construction. Until recently, the focus in education has been on learning about computers rather than on how to work with them in designing learning experiences. While there are many examples of the use of various information technologies (radio, audio, video, satellite and computer) for distance learners, and a recent increase in the numbers using online learning, many of these examples can be categorized as extensions of traditional classroom or distance learning practices rather than of constructivist learning strategies using technology.

There are many gaps in our knowledge about such online programs.

Technical issues focus on bandwidth, infrastructure, security, and various networking options.

Administrative issues include information about how to successfully introduce such changes into education, partnership development, funding, and sustainability.

Learning issues revolve around the need to identify and demonstrate various models of student learning which exploit the characteristics of the technologies, the lack of information on the influence of synchronous and asynchronous options on learning and the recognition that we need information on student achievement associated with these models.

Teaching issues are concerned with identifying and understanding teachers' needs and their attitudes towards technologies, providing professional development opportunities on designing and using the range of learning options associated with the new information technologies.

Content development issues identified the importance of developing virtual schooling models and multimedia online content modules designed to reflect different learning approaches that could be both teaching resources and which provided teachers with opportunities for their own professional growth.

The key policy questions are:

How can a stable infrastructure for developments in learning using new information technologies be ensured?

What are the economics and sustainability of programs based on new learning technologies?

In what ways have partnerships with private and/or other public sector partners been successful in providing quality technology-mediated learning opportunities?

What effective learning strategies and modes of learning have been developed which make most use of the capabilities of the new learning technologies?

What are the achievement outcomes of students who have undertaken online study?

How are experienced and new teachers being prepared to work with the new learning technologies?

How might the development of multimedia online learning resources be realised?

Introduction

In a recent study of virtual schooling and online programs Haughey and Muirhead, (1999), identified over 20 virtual programs offering grade 1-12 courses in Alberta alone, and several others in other provinces and territories. This development is not surprising. School boards and provincial/territorial ministries/departments have helped target spending on technology as an essential aspect of education for the twenty-first century. The advent of new information technologies and the development of alternative orientations towards learning has the potential to provide greater accessibility and equitable access leading to increased participation in primary, secondary and tertiary education for learners across the lifespan (Haughey & Anderson, 1998). It can radically change schooling at any level but if we are to take advantage of the potential of information technologies, then we have to both envision such alternatives and be cautious about easy promises (Fournier and MacKinnon, 1994).

New Learning Technologies

Canadians are generally acknowledged to have framed the modern discussion of technology through the writings of Grant, Innes, McLuhan, and Franklin (Goyder, 1997). Their sense of technology is as an aspect of our humanness, one which in its combination of knowing and acting, is the creative application of the known to achieve different goals or to resolve particular problems. Technology includes the notions of tool, associated techniques, its use of knowledge and materials, and its social effects. If technology is an outcome then placing computers in schools would have been sufficient to generate enthusiasm for their use, a position shown to be inadequate (Glennan, 1998). Technology

can be considered a tool, a process to help us meet selected goals but we should not forget that it shapes us even as we shape it (Bromley & Apple, 1998; Franklin, 1990; Goyder, 1997). “It is no panacea,” reminded Kerr (1996: p.xiv). Recent changes in education have also influenced our understanding of the possibilities of the new information technologies.

Changes in Education

The rapid rise in interest in the use of learning technologies has been linked to the restructuring of society and the reconceptualization of education in preparation for the changes predicted as new economic communities join the global village (Delors, 1996). While there are those who would question the extent to which a global knowledge-creating society is likely, there are many reasons why the present educational system finds it increasingly difficult to fulfil the objective of educating students. Research in various fields has challenged our previous notions of learning. Gardner (1985) has shown that intelligence is multi-faceted and that learning designs therefore should be more cognizant of these attributes. The present educational system stresses the importance of individual effort. Now, learning theorists suggest that students learn by building on what they know and that unless they test out these assumptions, further information will be reconfigured to fit this already developed and potentially inaccurate schema. Hence, they recommend that priority be given to group work, to encouraging students to work through an issue rather than to providing the information and asking students to show that they understand what has been taught, and to context-specific knowledge. (Duffy &Jonassen, 1992; Lave, 1991). While we want to avoid the obvious romanticism of technology as savior, the new information technologies are demonstrating their potential to transform

the educational system by helping to realise these recommendations (Bracewell, Breuleux, Laferrière, Benoit, and Abdous, 1998; Petragia, 1998).

At the same time, the world that our present schooling model was designed for—stable families, one working parent, high employment prospects for all—is no longer the norm and the issues and concerns of child poverty and youth unemployment have to be considered in any reconfiguration of education. More parents are choosing to educate their children at home; students are seeking to blend schooling and work place learning and there are more opportunities for students to begin post-secondary education while at school and to transfer between colleges and universities. The education system has to continue to be responsive to these initiatives and new information technologies have been one strategy for expanding options for learners.

Information Technologies and Schools

Since 1995, there has been increased emphases on the use of computing in schools, colleges and universities, and on the opportunities provided by online and distance learning. Looked at from a general perspective since the mid-80s, several waves of new learning technology innovation and integration are evident. The initial impetus focused on learning about computers and acquiring basic computing skills. Once it was possible to network computers, the emphasis moved from student skills to information sharing among administrators, parents and teachers as all the business practices of schools were moved onto private LANs, teachers e-mailed each other and student report cards were produced online. Also at this time, school libraries purchased CDROM databases and provided Internet access for library searches.

Although this was usually accompanied by the acquisition of more computers per school, it still made using computers in instruction difficult. In general, teachers used computers to extend their lessons through exchanging information with a class in a different location, and to research specific topics (SchoolNet (<http://www.schoolnet.ca/>) rather than to transform the way their students learned. Bracewell, et al. (1998) note that as these issues are resolved, teachers can focus on new pedagogical possibilities and quote Trentin (1996) who concluded that new learning technologies are “a key factor in the adoption of new methods supporting the teaching/learning process” (p. 11). However, while initial research results indicate benefits from the use of technology-mediated learning, there is a clear need for many studies on the design of online environments in classrooms (Bracewell et al., 1998).

Distance Learning

For distance educators, new information technologies provide the opportunity to facilitate learner-oriented, individually-designed instruction with students singly or in groups and to include an interactive component to a learning experience which can occur any where and at any time. This has encouraged the development of online learning programs and virtual schools, some private, others supported by public funds (Wynne, 1997). These new developments in distance learning provide jurisdictions and provinces and territories with options for those parents who want their children’s educational experiences to be in their own homes; for those whose children are medically fragile; those who are involved in sports, or artistic pursuits that require frequent travel; and those whose learning style is best met in a quiet focused environment. Such programs also provide access to quality instruction for those students in small school settings who are

without qualified teachers in those subjects and to those who want to blend in-school and virtual instruction for economic or lifestyle reasons. They can transform and integrate educational opportunities for both in-school and online learners at all educational levels.

Since 1919, Canada has been responding to the needs of those students who are unable, for various reasons to attend site-based schools. While a major focus is on meeting the needs of individual students who choose not to attend site-based schools because of health, lifestyle, or religious concerns, the provision of instruction to groups of students remains a continuing feature.

Although distance education has always depended on print, the various provincial schools experimented with audio-tape, radio, audio cassettes, and television as they became available. However, in many instances, the lack of in-school support for distance education students, meant that the general success rate was about 40 per cent. Once programs were instituted that used fax machines for faster feedback and included in-school support, completion rates rose to over 80 per cent (Gee, 1991; Clark & Haughey, 1990)

The shortcomings of a correspondence studies by mail model have also been addressed through the application of other learning technologies (Haughey & Roberts, 1996). Radio is used by Wahsa, a First Nations agency based in Sioux Lookout to provide community based schooling to Aboriginal communities in Northern Ontario. Video technologies has been used successfully in a number of provinces. In Saskatchewan and Manitoba, for example, some school jurisdictions have partnered together to provide compressed video-conferenced instruction among participating schools. In these situations, the instructor is at one school and students at the other school

sites are all considered part of the class. Manitoba and Saskatchewan also provide satellite-delivered interactive video instruction to schools through SCN, Saskatchewan Satellite Network, and MSN, Manitoba Satellite Network. In Saskatchewan, SCN, in cooperation with the provincial Correspondence School, provides a service in which teachers at three school sites broadcast 13 high school courses to any of the 118 schools which can receive the service. The one-way video programs are broadcast live to the schools and the students respond using telephones (Svendahl & McLeod, 1996). In Ontario, TVO has begun providing interactive television to selected school sites as part of the Galaxy project (Boak, Engemann, Kirkwood, & Mitchell, 1996), and in British Columbia, the New Directions in Distance Learning (NDDL) project, based on a partnership of the Ministry of Education's Technology and Distance Education branch, which included the distance education schools, and Open School, a unit of the Open Learning Agency, developed and offered multi-media instruction to participating schools. David Porter, the Director, suggested that the combination of synchronous and asynchronous technologies used in NDDL was behind the consistently high success rates (70 to 80 per cent completion) of their courses (Haughey & Anderson, 1998). This program, renamed CONNECT, is now coordinated by the provincial distance education schools.

Other jurisdictions have focused on audio technologies. Audio-conferencing is used extensively in Newfoundland and Labrador where the integration of audio-graphics enables students to see what the teacher is writing and to respond on a similar graphics tablet which is broadcast to all the sites. In 1996, 15 teachers from eight communities offered audio-conferenced courses to 950 students from 74 different communities.

Contact North/Nord which operates out of Thunder Bay and serves Northern Ontario provides a similar service to the over 180 schools who are part of its network. McGreal and Violette (1993) noted that students did as well or better than their counterparts in classroom courses and that the benefits included working in their own familiar surroundings, in addition to the benefit of invisibility that lessened the stress of participation, and with a feeling of a common experience due to the small class size and the camaraderie which developed among teachers and students (p. 203). As well, smaller networks Francophone schools have begun to use audio-conferencing and Internet-based conferencing to provide course instruction to their members.

Manitoba also uses its audio-conferencing system to provide courses from teachers at lead schools to students at participating sites. Students who use the audio-conferencing system for participating in instruction use the provincial computer network, MINET, to e-mail their assignments and questions to their teacher. TeleEducation New Brunswick is a provincial system that provides audio, video and computer-conferencing to over 100 community centres in New Brunswick. In 1997/8 an upper level Chemistry course and the East-West consortium Technology course were offered and the Technology course was repeated in French and English in Fall, 1998. Network Nova Scotia has successfully offered a variety of courses in accounting, business, calculus, geography, geology and oceanography to participating secondary schools. Limiting factors have been the cost of long distance charges and the differing timetables among the participating schools. Recently, some of the Network schools began to explore use of whiteboard technology to supplement audio-conferencing through EdNet, the provincial

computer network, while some others have opted to explore instructing the course entirely online.

Online schooling

Schools and jurisdictions seeking to expand access to learning opportunities for their students have begun to explore the potential of online programs. Although the numbers are still relatively small, there has been a steady increase in the numbers of virtual programs which have become available in Canada over the last two years. Some have been undertaken by provincial distance education units, while others have been initiated by schools and jurisdictions anxious to explore the potential of this technology for meeting their needs. A third group of developers have been private schools and organizations who are targeting specific groups.

Provincial distance learning schools have been gradually adapting their print-based courses to include electronic teacher assessment and student response forms, Web pages and opportunities for student-instructor interaction. The distance education schools in British Columbia have been putting their courses on line since 1994. North Island Distance Education School at Comox, Vancouver Island, provides students with modems, Internet access and technical support so that they can correspond with their instructor and other students online. There are similar projects in the other distance education schools. As well, a number of the schools provide sites for the 28 secondary school courses available through project CONNECT (formerly NDDL). Students register for the program at designated sites. The instructor corresponds with students by audio-graphics conferencing, computer-conferencing, and one-on-one telephone tutoring. A teacher-

facilitator is present at the each of the study sites to provide assistance and monitor student progress.

In Ontario, the provincial distance learning school, the Independent Learning Centre, has also been working on integrating computer response forms and Web pages into all its course offerings. It successfully piloted and is now offering an environmental science course online and has participated with TVO in offering courses via their Virtual Classroom. As well, ILC has developed two courses on CDROM which include media clips and links to the Internet. The Alberta Distance Learning Centre, which is now operated by a school jurisdiction, has also begun to adapt its courses for electronic interaction and resource accessing. It provides online schooling through the ADLC Online School. Some students register directly with ADLC while others are part of the Online in the Classroom program which provides services for students in small enrollment schools. ADLC Online has been experimenting with group synchronous software to help develop virtual classes and increase group participation.

School educators also see potential value in providing students with opportunities for online learning and have begun offering online courses as part of their regular program. For example, Garden Valley Collegiate, Winkler, Manitoba, began using the school LAN to provide additional courses in 1995. At present, four courses, developed by school staff, are offered to senior students who are already registered at the school. The courses can be accessed in school or from home. North Hastings High School, Bancroft, Ontario, (<http://www/hcbe.edu.on.ca/nhhs/nhhs.htm>) offers a senior art course from the Ontario College of Art, "Art Online", which can be accessed from school or home and is developing other interactive courses for its rural students. The Dufferin-Peel Catholic

School Board operates an online school named Webschool (<http://webschool.dprcssb.edu.on.ca/>). It was originally designed by their continuing studies department as a pilot offering of a grade 11 computer studies course online for evening students. Since computing courses in many of the district schools are over-subscribed, they now offer grade 11 and 12 computing courses to day students through Webschool. The courses are between 50 and 75% online and after a series of initial classroom meetings to ensure students can use the conferencing software, a sequence of in-school and online conferences are identified.

Some schools in Alberta opted to provide virtual programs to coordinate the services they provided to home schooled students, to students who had not been successful in the site-based school programs, and to those interested in distance education (Academy On-line, Innisfail; CMOS Centre, Edberg; Cyber Academy, Lacombe; Golden Hills Virtual School, Strathmore; InterEd, Nishu) while another provided students with the opportunity to accelerate their education by completing more than one year of schooling during a regular school year (Computer Link, Fort McMurray).

Some jurisdictions have set up a virtual program for students in their districts. In Alberta almost all of the jurisdictions in the province have either their own online program or have contracted with ADLC Online or another jurisdiction to provide services to their students.

Fort Vermilion School Division, Ft. Vermilion, AB, offers in-school virtual courses among its five high school programs using its own Wide Area Network. Initially developed through the Distance Learning Project North (Clark & Haughey, 1990), the program was based on audio-conferencing technology. Recently the entire system has

moved to computer conferencing software. Students and teacher are together online at regularly scheduled times and students can use e-mail to access the teacher outside class. Long-range data show that students in these courses score above the average for the province. A similar program is available on an Intranet at Vista School District , NF (Piper, Power, and Stevens (1998).

Peace Academy of Virtual Education is an initiative of the Peace-Wapiti Regional Division, AB. The program for grades 3-9 requires adult supervision in the home. As well, the program provides a yearly school orientation to the district and the technology and monthly callback sessions for field trips, group instructional activities and group projects. The course work is accessed electronically and daily teacher contact is encouraged. While student interaction is asynchronous at present, the jurisdiction is working towards a more interactive framework for instruction. Two neighboring jurisdictions have recently become educational partners in the program and course materials for selected courses for two low-enrolment high schools are being developed.

The formation of partnerships among jurisdictions has been important in sharing scarce resources and achieving economies of scale. The EDEN (Electronic Distributive Education Network) project (<http://eden.scbe.on.ca>) is the result of a consortium of six major Ontario school boards (Simcoe County, York Region, Toronto, Upper Canada, Hamilton/Wentworth, and Dufferin-Peel Catholic) in collaboration with the teacher unions, the Ontario College of Teachers and the Ministry of Education and Training. The project was begun in February 1995 by the Orillia Learning Centre, an adult education and student upgrading centre for students in Simcoe County District School Board. To date, the Centre offers seven secondary level courses online with a major expansion in

course offerings to be completed within four years. The Centre offers three delivery formats. They provide courses to groups: students in small enrolment schools linked electronically to form virtual classes. Interaction is asynchronous so students do not have to be online at the same time. They also provide courses to teachers in classrooms who are offering different courses in the same time slot. The teacher provides the monitoring, motivation and facilitation to students who access their courses online asynchronously. And they offer courses to students in a computer lab setting who are taking the same or different courses at the same time. The teacher provides coaching and facilitation and coaching to the group. To help teachers be most effective in these situations, the project also provides a teacher in-service program.

The Greater St. Albert Catholic Regional Division and Red Deer Catholic Regional Division, Alberta, chose to combine resources to provide services for both school districts. Together Good Shepherd Cyber School (Red Deer) and St. Gabriel Cyber School (St Albert) provide courses for grades 6-9 and Virtual St. Albert Catholic High School offers a comprehensive high school program for grades 10-12 (<http://www.sachs.st-albert.ab.ca/virtual/Teachers/admin.htm>). Students access materials through the Internet, assignments are posted weekly and are returned to teachers electronically. Whiteboards are used for synchronous instruction and discussion and the use of audio-streaming is being explored.

While most jurisdictions have focused on providing services for their own students, at least four Alberta districts besides ADLC, have adopted a province-wide mandate. They are St. Paul's Academy (<http://www.redeemer.ab.ca>), School of Hope

(<http://www.schoolofhope.org>), Holy Family CyberHigh Virtual School

(<http://www.cyberhigh.com>), and LearnNet, (<http://axis.epsb.edmonton.ab.ca/learnnet/>).

LearnNet (Edmonton Public Schools, AB) is a comprehensive online program which students access over the Internet. Its 500 students include Canadian students in a number of different countries. Each course is organized into units or projects which students download to their home computers. LearnNet materials provide objectives and learning outcomes for each module and suggest alternative assignments which students can undertake to demonstrate proficiency. As well students, who are all assigned to a “home room” teacher, must send in regular agendas and assignments, and participate in selected computer conferences with peers.

School of Hope (East Central Alberta Catholic Separate School Division, Vermilion, AB) which has been in operation since 1996 has a student enrolment of over 1800. The course materials which have been developed by the teachers follow a skills, resources and assessment model. Parents and teacher and student work cooperatively to develop a yearly educational plan which is personalized for each student. Resources are selected jointly and parents can obtain advice about the instructional strategies they should use to assist students and decide on their extent of involvement in various subjects. Teachers provide continuous assessment of written work, portfolios, electronic submissions and art samples and are always available for advice and assistance.

Holy Family Cyberhigh Virtual School (Holy Family Catholic Regional Division, High Prairie, AB) serves about 180 students from the division, across Alberta and internationally, primarily from the United States. Teacher-developed materials are supplemented with commercial products and provincially-developed Learning

Technologies Branch course materials. The program which is going completely online is self-paced but students are required to provide weekly assignments and contact teachers regularly. Most of the interaction is asynchronous but the teachers also provide synchronous discussion to answer student questions and provide more in-depth explanations. There are three callbacks each year for computer training, parent-teacher interviews and group activities from science fairs to sports.

Two jurisdictions in British Columbia offer virtual programs for students regardless of location; the Nechako Electronic Busing program and the Langley Electronic Busing Program. The purpose of the Nechako program (<http://www.e-bus.com>) is to provide a parent-directed, publicly-supported individualized learning program to students schooled at home. The online teachers who are responsible for the support, enhancement and assessment of students' learning in collaboration with the teaching parents, provide assistance with curriculum design and implementation, access to standardized, diagnostic and provincial assessments, and help in identifying suitable problem-solving and instructional strategies and resources.

Jurisdictions have also sought private sponsors as partners for their virtual programs. For example, the Avon Maitland Board, Goderich, ON, opened The Virtual High School (<http://www.virtualhighschool.com/>) to students in January, 1997. Business partners include Silicon graphics, Inc. who have set up a model lab in one of the district's schools, TRO Learning (Canada) Inc. which focuses on self-paced comprehensive instruction and testing systems, and HuronWeb Online who offer web-site design, creation and management services. The Virtual High School is part of the Cyberschool initiatives of the Board and offers high school courses for credit to students regardless of

home jurisdiction or country. While four courses are presently being offered, the staff plan to offer the full complement of high school courses. The courses are completely online and generally have no paper textbooks or manuals.

Private-sector organizations have also become involved in online programs. The Toronto Virtual School (<http://www.intronto.com/virtualschool/>) is an entrepreneurial online service focused on mathematics in grades 8 to 12. The learning materials involve lesson units with step-by-step material presentations, and interactive exercises and tests. In contrast, Northstar Academy (<http://www.northstar-academy.org/>) is a private Christian online school offering grades 7-12. It provides both Canadian and United States programs in most subjects. Students registered with the school receive printed materials and participate with their teachers and peers in group discussions and presentations via commercial group conferencing software.

Post-secondary Education

The potential for technology-mediated learning is also influencing site-based as well as traditional distance education formats in post-secondary education (Haughey & Anderson, 1998). Like schooling, the developments in distance learning have involved print and audio or video-conferencing but there has been a greater expansion of on-campus virtual programming often as a supplement to instruction. Given the emphasis on individual study in post-secondary education, the implementation of various alternative learning options based on new learning technologies could revolutionize the traditional lecture format and provide greater options for students and institutions (CMEC, 1994; Bates, 1995). The current trend towards resource-based, learner-centred, and personalized learning models will provide new challenges for post-secondary educators as they

attempt to design course materials that are engaging, timely and cost effective for a multi-media environment where commercial producers are competitors. Space did not permit detailed discussion of post-secondary developments but the same policy issues apply.

Key Policy Questions For Research

In terms of new learning technologies, five key policy areas have been identified:

Technical

How can a stable infrastructure for developments in learning using new information technologies be ensured?

Issues: infrastructure and bandwidth considerations, security, support, links with ISPs, intranets

Infrastructure and bandwidth are essential considerations if educators and students are to be able to focus on learning rather than technical concerns. Bandwidth refers to the measure of the capacity of information that can be transmitted over a communications channel such as a telephone or data line. Although it is not a concern in urban centres, it is a different situation in rural areas. While the capacity or bandwidth of urban lines is sufficient to allow for reasonably fast transmission of information and uploading and downloading of messages, in rural areas the narrower bandwidth means that such tasks take much more time and that the transfer of files with audio and/or video components is likely to cause difficulty.

As well, the location of servers is another issue. Servers are programs that run on computers connected to the Internet that provide information and perform services in response to requests from remote users. They should be positioned close to the majority of users to reduce long distance costs and to the greatest bandwidth to expedite

operations. Some jurisdictions have examined the use of wireless instead of telephone lines to reduce operating costs and overcome issues such as remoteness and permafrost. Others have looked into leasing lines and becoming their own Internet provider. This allows the jurisdiction to provide programs on increased bandwidth and to control or eliminate dial-up and access costs. It is likely that in any province or territory, some combination of land lines, wireless and satellite transmissions will be required. As well, some provinces and territories are considering setting up their own provincial learning networks to ameliorate disparities in access, enable consistent technical standards, and ensure cost efficiencies.

Another network issue involves students accessing inappropriate content and hence the importance of having an end user acceptable use policy that all students sign unless all programs are on a secure server on which filtering programs such as NetNanny can be used. As well, there is limited security for Web-based programs accessible from a home page. Password-protected sites provide an elementary form of protection against the casual browser but no site is completely secure. Hopefully, the Second Information Technology Study which will gather information on the facilities, use and obstacles associated with implementation of new technologies will provide insights concerning the numbers of students who have access to computers and the learning strategies used.

Administrative

What are the economics and sustainability of programs based on new learning technologies?

In what ways have partnerships with private and/or other public sector partners been successful in providing quality technology-mediated learning opportunities?

Issues: partnership, funding, sustainability, policy environments

The development of technology-mediated learning activities that encourage learner involvement and autonomy and use collaborative learning processes requires a change not only within the classroom but throughout the educational system. Pressures to develop more democratic and collaborative professional working environments compete with pressures to use teacher-prepared content to achieve increased achievement results. Research makes clear that it is difficult to sustain school change unless there is both top-down and bottom-up support for local development (Fullan, 1993 Seashore Louis, Marks, & Kruse, 1996).

As is evident from practice, many jurisdictions are looking to partnerships to assist in enhancing their services while holding down costs. These vary from combinations of schools within a jurisdiction (Saskatchewan's Evergreen videoconferencing project), to combinations of jurisdictions (Ontario's EDEN project), to national or international partnerships (Athabasca University and TéléUniversité, and University of Waterloo and the British Open University). They include partnerships with private sector partners from computer companies and Web designers to multimedia producers and telephone companies. In all these situation, many issues of responsibility, accountability, resource allocation and coordination have to be addressed. For example, issues around cross-jurisdictional offerings include who pays for connectivity costs, who decides which courses will be offered, who schedules multi-site classrooms and who claims the students.

Fiscal concerns are a major impetus for partnerships but can also prove to be a major barrier. The provision of appropriate hardware and software requires extensive

outlays. The provision of an appropriate infrastructure requires not only sufficient capital but operating allocations for room rewiring, equipment upgrading, and technical support. Not enough is known about start-up and maintenance costs of line connections, software, hardware, technical support, upgrades and infrastructure.

Sustainability is another important concern not only in terms of ensuring the relative currency of the equipment but also in terms of the staff involved. Technology-mediated learning initiatives require high learning curves from staff and extensive amounts of time. Without due consideration of these factors, staff are likely to sustain burnout. Many of the programs have small enrollments. Are there size thresholds which should be used to make decisions about sustainability and funding increases? Would partnerships of jurisdictions address these concerns?

Learning

What effective learning strategies and modes of learning have been developed which make most use of the capabilities of the new learning technologies?

What are the achievement outcomes of students who have undertaken online study?

Issues: Learning strategies, synchronous/asynchronous patterns of interaction, group software concerns, academic outcomes, completion rates, student, teacher, and parent satisfaction outcomes

While the questions of student outcomes and parent satisfaction are the most frequently mentioned areas for exploration, such information is incomplete unless there is information on how the learning strategies employed took advantage of the capabilities of the medium. Some programs build heavily on collaborative computer conferencing, and active learning strategies while others use a format similar to whole group

instruction—explanation, questions, individual work assignment. There is little research information available on the strategies teachers use in designing for online instruction and the influence of these on student achievement. As well, we know little about the value of synchronous over asynchronous interaction for developing a community of learners and its importance to students. To date, well-developed synchronous group interaction software which will run without major time delays and loss of graphics on smaller bandwidths has not been developed.

Teaching

How are experienced and new teachers being prepared to work with the new learning technologies?

Issues: professional development, teaching strategies for technology-mediated learning

Many of the online programs sought teachers who were experienced, comfortable and competent with technology, and knowledgeable about program requirements and content resources. They were expected to be able to personalize or modify objectives and to work from a student-oriented perspective. Their ability to initiate and sustain oral conversations and written communications was mentioned frequently as was flexibility, patience, relationship-building and keeping communication opportunities open for students and parents (Haughey & Muirhead, 1999). Such teachers are also in demand for in-school instruction. For programs in the first two years of implementation, there was little information on in-service education and professional development at the jurisdictional level. This was one area where provincial initiatives and/or collaboration among jurisdictions were welcomed.

As well, teachers need to be able to employ the wide range of strategies which take advantage of the capabilities of the technologies (Harris, 1998; Haughey & Anderson, 1998). This means developing new pedagogical approaches with all the attendant risk that this poses for student motivation and achievement since such changes are unlikely to show an immediate increase in student achievement scores.

Content development

How might the development of multimedia online learning resources be realised?

Issues: multimedia development of online/CDROM learning resources, virtual program models

Preliminary analysis of virtual program models suggests that they are extensions of current schooling models rather than reconfigurations of learning, and that they need to be rethought within the larger context of developments in learning, pedagogy, and multimedia design (Bracewell et al., 1998; Haughey & Muirhead, 1999). More attention needs to be given to the design of online learning strategies and resources. We lack virtual program models that exploit the possibilities of the new technologies and are designed to encourage collaborative and authentic learning. We need a library of high-quality multimedia resources available online which teachers can access for individual student or small group work and which will help teachers become comfortable in working with these new pedagogies. These materials need to be in small units and developed from different instructional perspectives so that teachers can choose among several options. This set of resources could be the outcome of a distributed resources model where multiple content developers contribute to a range of instructional resources which are available to students in a variety of technological formats and settings.

Synthesis

For many reasons, the reconceptualization of education should include the opportunities provided by the new learning technologies. As Kerr (1996), the editor of the National Society for the Study of Education Yearbook on Technology and the future of schooling pointed out,

education is a fundamentally human, not a technical or economic activity....Education is characterized today by countervailing forces. Some interpret technology as merely a tool for improving the way we do things now, a set of devices and procedures that allow us to extend the efficiency and effectiveness of schooling without altering the underlying assumptions about the roles and relationships of the students, teachers, parents and administrators involved. The possibility of seeing technology as a very different kind of tool—one oriented towards the development of individual capacities in a social context and towards restructuring the work of schools—is more rarely suggested.... the task of re-conceiving how we think about technology is not a small one, but it is one we need to confront (p.25).

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