

# K-12 Teachers and Learners in an Electronic World: A Review of the Literature

## Part I: Context, Learning Outcomes and Pedagogical Implications

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## Part I: Context, Learning Outcomes and Pedagogical Implications

### **Abstract**

Current literature relating to information and communication technologies (ICT) in K-12 teaching and learning offers positive and cautionary perspectives. Overall, there exists great optimism about the benefits of ICT-mediated learning for students. Below, we review literature on ICTs in K-12 education, with emphasis on technology-supported constructivist learning, the challenges and pedagogical implications of educational technologies, changing roles for teachers, and technology in the classroom. In Part II, we will review literature on K-12 learner issues that can affect successful learning using ICTs. We will report on learner satisfaction with online learning, current thinking on skills of successful online students, and existing theoretical discussions of technology and learning styles. We will review student diversity and ICT-mediated learning, student differences, which challenge online learning, and the opportunities offered by ICTs for particular subgroups of learners. Overall, we offer a snapshot of current literature on effectiveness of ICT-mediated learning from the perspective of the K-12 learner.

## Introduction

*“The teacher as primary source of knowledge no longer suffices in a world where knowledge doubles every seven years and 10,000 scientific articles are published every day”*

(Forman, 1987)

Established educational systems are currently experiencing great challenges – the result of ever-increasing use of information and communications technologies (ICTs) in teaching and learning. The educational significance of previous audio-visual technologies in schools and classrooms, (film, video, CD ROM), pales in comparison with the capacities of the Internet to integrate information and knowledge resources, and to stimulate new forms of educational interaction.

A well developed literature already exists that both charts and speculates about the impact of information and communication technologies on established social, cultural and economic systems, including education. The term *disruptive technology* is often used in relation to ICTs, emphasizing the technology’s power to transform, rather than facilitate or enhance existing systems, technological or otherwise. The dilemma for educators today is that we are in the middle of the disruptive process with little clarity about its eventual scope or duration. To steal an image from *The Wizard of OZ*, we’re still very much in Dorothy’s house being spun by the tornado, and no matter how hard we try to fix our position within that spin we know we haven’t quite landed yet.

There are two important reasons for emphasizing the notion of disruptive technologies at the early stages of this literature review. First, it cautions us, within the context of much broader social change, to view current strategies for providing structure and method for the uses of new

technologies (course management tools, for example) as inherently experimental rather than proscriptive in any way. Second, it reminds us that working and experimenting with powerful new tools stimulate the need for increased discussion of educational intentions and goals, not less.

Popular literature about the potential benefits and limitations of technology use has a long history within education. In recent years educators like Neil Postman and David Noble have vehemently stressed what they feel to be the deleterious effects on individuals and society of jumping too quickly on the learning technology bandwagon. Other popular and academic writers like Jeremy Rifkin in *The Age of Access*, Donald Tapscott in *Growing Up Digital*, or Ursula Franklin in *The Real World of Technology*, have reported and commented upon emerging social and economic patterns they associate with widespread uses of technology. The contrast between optimism and pessimism in these books is typical of works written during periods of significant technological change when so much remains unknown. More interesting perhaps, are the specific themes of analysis within the individual works which can contribute to critical understanding of larger issues at play, such as public policy regarding intellectual property, civic discourse and social control, the privatization of knowledge, and the digital divide, to name just a few.

## **Review Methodology**

This literature survey was carried out by searching Internet sources and Journal Databases accessible through the University of British Columbia (UBC) Library, between July and October 2002.

Internet searching was carried out using the “Google.ca” search engine, and by manually visiting publication sites for known centres of research and theory in uses of educational technology. Library indices searched include the ERIC (Educational Resources Information Centre) Database, and the SilverPlatter WebSPIRS Database “The Education Index” (1983-2002), and the e-journal collection at UBC and Royal Roads University. This literature review aims to provide a synthesis of current theory and recent research relevant to the application of ICTs in K-12 education.

Questions guiding part one of this review included:

- What are the implications of educational technologies for K-12 pedagogy?
- How does the use of ICTs affect student learning and achievement?
- What are the skills of effective online teachers?
- Are there areas of study that are more or less appropriate for online learning?

## **Overview of Writing and Research on ICTs in K-12 Education**

The rhetoric related to integrating technology into learning currently pervades every area of educational theory. Scholars argue for and against definitions, terminology, values and appropriateness of technology integration. It is often assumed that integrating technology into learning radically changes the way that schools should be designed and administered, and the way that we teach, learn and work. Meanwhile, new technologies are being rapidly introduced into learning environments even before we learn how to make effective use of existing technologies (Koszalska & Wang, 2002).

As Kearsley (2000) points out, online education is currently being used most extensively at universities and colleges across North America. In part, he argues, this is due to the easy

availability of computers, networks, and technical support (since the WorldWide Web was developed as a University research network). The maturity, motivation and technological sophistication of college-level students have also fostered the implementation of online learning programs that require students to have organizational ability and independent study skills.

Kearsley suggests that the significant value of the Internet for K-12 education is that it functions as a “gigantic library and field trip combined”, so that students are no longer confined to single textbook sources, or restricted by their geographic location. Building on this strength, educators, academics and administrators have begun to realize that ICTs offer even more educational possibilities at the K-12 level. Reviews and policy documents are now proliferating on the “Potentials, Parameters and Prospects” of Educational Technologies (Haddad & Draxler, 2002; Barker, Wendel, & Richmond, 1999; Web-Based Education Commission, 2000; Council of Ministers of Education, Canada, 1997; National Foundation for the Improvement of Education, 2000).

While more and more schools are integrating learning technologies into the classroom, and experimenting with provision of some online or distance courses, “virtual schools” are emerging at the leading edge of the wave of educational technologies. Different types of virtual school organizations – defined as “ a structured learning environment wherein the program, under the complete supervision of a teacher, is delivered electronically to students who are at home or in a physical setting that is other than that of the teacher” (Alberta Education, 1999) – include: university-based virtual schools, virtual school consortia, virtual schools operated by schools and districts, virtual charter schools and virtual private schools. A recent study projected that 40,000-50,000 K-12 U.S. students would enroll in an online course in 2001-2002. Currently, 14 states in the US have planned or operational virtual schools (Clark, 2001). In

Canada, Alberta has led the way in virtual schooling, but virtual schools now exist across the country (Barker & Wendel, 2001).

Although much opinion has already been published related to the value of online learning (for example, its costs and benefits, strategies for maximizing school connectivity, and requirements for good instructional design), insufficient funds have been spent on research to determine the educational effectiveness of these technologies (Web-Based Education Commission, 2000). In 1999, less than 0.1% of the United States education budget for public K-12 education related to learning technologies was put aside for research on the educational effectiveness of ICTs. Ungerleider & Burns (2002) argue, moreover, that “few, if any, claims [regarding the contribution of computer technologies to teaching and learning in elementary and secondary schools] are sufficiently well researched or well evidence to provide direction for policy” and provide a detailed critique of a number of recent research studies. In addition, almost all research on online programs is currently at the post-secondary level, and reports of success in higher education programs with mature learners do not necessarily imply that similar programs will be successful for students in the middle grades (Litke, 1998). Consequently, definitive research in this area remains sparse and does not yet present a coherent, comprehensive picture of online learning practices, their educational benefits and limitations.

## **Learning with Technology: Theory and Case Studies**

### **Technology Supported Constructivist Learning**

By the late 1990s the conception of the role of technology in education had altered from “computer as instrument of change” to “computer as learning tool” (Bales, 2001). “The Role of Online Communications in Schools: A National Study” by Follansbee, Hughes, Pisha, & Stahl

(1997) demonstrates that students with online access perform better. The study, conducted by CAST (Center for Applied Special Technology, an independent research and development organization), isolates the impact of online use and measures its effect on student learning in the classroom. It compared the work of 500 students in fourth-grade and sixth-grade classes in seven urban school districts (Chicago, Dayton, Detroit, Memphis, Miami, Oakland, and Washington DC) - half with online access and half without.

The study found significantly higher scores on measurements of information management, communication, and presentation of ideas for experimental groups with online access than for control groups with no online access. It offers evidence that using the Internet can help students become independent, critical thinkers, able to find information, organize and evaluate it, and then effectively express their new knowledge and ideas in compelling ways.

Pringle (2002) argues that the benefits of online learning for students include a nurturing of self-learning ability as they acquire not just explicit, formal knowledge, but also the ability to behave as community members. This author suggests that learning in community-based online settings draws attention away from the abstractness of ideas presented in the absence of context and negotiation, and focuses on communities in which knowledge takes on authentic meaning for its members.

Bracewell & Laferriere (1996) have questioned whether it will ever be possible to pinpoint the actual learning that is achieved or not achieved through the use of learning technologies. While the complexity and inter-relatedness of learning systems does indeed make a holistic analysis difficult, constructivist learning theory, informed by cognitive psychology, educational research, and neurological science, allows us to examine distinct areas of learning that can be supported by technology. Constructivist learning theory views learning as the product of both

experience and social interaction. Learning is considered an individual and personal event (Southwest Educational Development Laboratory, 1999). Below, we discuss further research findings on the uses and impact of technology on learning. This research supports the following principles of constructivist learning theory, especially for K-12 students:

*Principle: Learning is internally controlled and mediated. Learners take in information, process it to fit their personal frameworks, and build new understanding.*

*Principle: Knowledge is constructed in multiple ways, through a variety of tools, resources, experiences, and contexts.*

Australia is a leader in the integration of Internet and computer technologies at all levels of education. A significant and wide-ranging report produced by the South Australia Department of Education (Department of Employment, etc. 1996) describes a number of detailed case studies in which educational technologies were integrated into teaching a range of academic content for students from Kindergarten to the Grade 12 level. This extensive study concluded, amongst other findings, that learning technologies have a major impact on resource-based learning, because they allow access to current and reliable 'real world' information. Students have access to multiple resources, and become engaged in real world issues and simulations that previously were not feasible to include.

In another recent study on the impact of technology on student literacy (McNabb, Hassel & Steiner, 2002), teachers reported that Internet-based learning activities made reading enjoyable for students, fostered use of critical reading skills, and promoted reading fluency. These authors also report that such activities enhanced understanding of content.

Internet-based learning activities have been reported to change and diversify students' learning strategies, to increase student motivation (Wishart & Blease, 1999), to promote in students a 'research spirit', to enable students to explore and represent information dynamically and in many forms (Coley, Cradler & Engel, 1997), to promote broader cooperation among students, and, most significantly, to promote more integrated and better assimilated learning, with students more closely associated with the assessment of their own learning (Bracewell & Laferriere, 1996).

*Principle: Learning is a process of accommodation, assimilation, or rejection to construct new conceptual structures, meaningful representations, or new mental models.*

Students engaged in Internet-based learning activities have been shown to develop higher order literacy skills – such as organizing information according to research questions, comparing and contrasting, and synthesizing information into new and meaningful structures (McNabb et al., 2002).

Brophy, Biswas, Katzlberger, Bransford, & Schwartz (1999) describe how an experimental computer-based learning environment can promote “learning by teaching”. In the environment created by these researchers, students are invited to learn by instructing “teachable agents” (TAs) who must then venture forth and attempt to solve problems that require knowledge of disciplines such as mathematics, science or history. These teachable agents have both a “knowledge dimension” and a “personality dimension” (for example, some may be impetuous, not listen or collaborate well, etc.). These authors found that this helped students to focus not only on academic content, but also on the characteristics of “difficult agents” that interfered with learning. Students showed great perseverance in their attempts to teach their TA. They used a

range of resources, and revised their own understanding for several weeks without losing interest.

*Principle: Learning is both an active and reflective process. Learners combine experience (action) and thought (reflection) to build meaning.*

Even in the early 1980s, projects in which basic numeracy and literacy precepts were reinforced through simple computer-based drill-and-practice exercises showed that students achieved consistently high learning outcomes. Later, researchers found that use of word-processing software, even by very young elementary students, allowed students to focus on content and editing of compositions, and later to transfer these skills to other media. Elsewhere, a collaborative (cross-institution) online newspaper composition project resulted in elevated reading comprehension, reading vocabulary and written expression in upper elementary-grade students (Bracewell & Laferriere, 1996). Students became independent learners and self-starters (Coley et al., 1997).

*Principle: Social interaction introduces multiple perspectives through reflection, collaboration, negotiation, and shared meaning.*

Bales (2001) reports that young (upper primary) students participated well in interactive and cooperative online text-based “literature circles” and that the enthusiasm, commitment and learning that the students demonstrated belied her belief that students would not respond well in a text-based environment (although a separate age-appropriate discussion area was necessary to allow good student participation). Students’ typing skills and screen-reading ability improved with time, as well as their ability to follow discussion threads. Students participating in the

Apple Classroom of Tomorrow (ACOT) study (Fisher, Dwyer & Yocam, 1996) became more socially aware and confident, and worked well collaboratively.

One case study of an Alberta-based “virtual high school” learning environment for middle grade students who were unable or unwilling to attend regular school demonstrated additional benefits of online learning. Teachers participating in this program felt that it provided an education superior to traditional home schooling (correspondence) options, that it offered greater program flexibility to these students, and that students experienced an increase in social interaction compared with traditional home schooling. They felt that this made online learning a viable option for students unhappy at school, and an alternative to expulsion.

### **Challenges of Online Learning**

Teachers and learners have experienced a number of challenges in these early years of online learning, and it will be valuable to consider these issues in the design and implementation of future projects.

The learning context and classroom culture can exert a significant influence on the success of student learning (where culture is taken to mean a set of shared beliefs held by and acted upon by participants in that culture) (Buckley, Gobert, & Christie, 2002). Several studies have demonstrated that teacher attitudes to technology are key to student success. When the teacher is very positive about the value of technology or software, students’ learning scores improve (Office of Learning Technologies, 2000). Other studies conclude that teachers themselves need to have well-developed self-directed learning habits themselves in order to research, develop, and implement Internet-based curricular activities. They need pre-service and in-service preparation focused on strategies for fostering students’ learning habits (McNabb et al., 2002).

Teachers have listed a number of other difficulties encountered in online learning projects. These include students missing deadlines and not completing assignments, a perception that the technology-based learning environment was still inferior to the classroom, a lack of personal relationships with students and parents, the loss of discussion, stories and “teachable moments”, the lack of parental involvement, responsibility and authority issues, a lack of time, occasional inappropriate use of email (profanity), problems with communicating instructions in text form, and difficulty in dealing with students whose major problems were academic (Litke, 1998).

In a recent study, Kreijns, Kirschner & Jochems (2002), focus on the reality of knowledge construction as a social process, and the barriers to achievement of desired social interaction in current technological renderings of online collaborative learning environments. They report that group interaction is often “assumed” (not facilitated), and the importance of the social and psychological dimensions of social interaction outside of the task contexts is often overlooked.

To the surprise of another research team, students in an online learning (virtual schooling) study barely mentioned technical difficulties as a problem with their participation in virtual programming. Instead, students cited isolation at home, lack of personal contact with teachers and classmates, and distractions such as computer games as the major weaknesses of the online environment. Other weaknesses included inappropriate use of email, and slow responses to email by teachers. In addition, some students complained that they experienced headaches from working at the computers for long periods (Litke, 1998).

Challenges to student learning and comprehension in a resource-based investigation and writing project are described in an ethnographic report on a project to integrate literacy and

technology in a fourth grade urban US classroom. These included students' difficulty in analyzing the quality of sources, students' difficulties in creating substantive products that went beyond simply being “flashy”, students' difficulty in dealing with conflicting or inaccurate information, the difficulty of ensuring that students were reporting accurate information, and students' privacy issues in a ‘shared classroom computer’ setting. Significant teacher guidance was required to assist students in finding informative sources, to help them assess the accuracy of source material and to guide them in the production of reports that were more than simple reproductions of source material. In addition, the teacher was also faced with the difficulty of assessing information cited (and not cited) by multiple students. A further challenge experienced by students was the ‘public’ nature of their on-screen work. A combination of teacher guidance regarding behaviour and agreements on computer usage was necessary to reduce student anxiety (Baker, 2000).

### **“No Significant Difference” and the Challenge of Evaluation**

Much of the distance education and online learning literature of recent years has touched on the issue of “no significant difference”, sparked by the influential work of Thomas L. Russell, who made the phrase popular in 1999. Russell used 355 research reports, summaries and papers to compile a comprehensive research bibliography on technology use for and in distance education. The central finding detailed in his book was that within this considerable volume of literature, most researchers had concluded that there is no real difference in the learning outcomes achieved with or without technology. Statements such as “There were no significant differences in the test scores for the classes measured... same class, same instructor, same audience, same exam – just different format...” (Clarke, 1999) began to appear in the literature,

and a dominant opinion expressed was that online learning was “comparable to” and “as effective as” classroom learning, but not necessarily all that different. Other authors acknowledged differences but concluded that they were not significant (see, for example, Wade, 1999; Trinkle, 1999; Smeaton & Keogh, 1999; Johnson, Aragon, Shaik & Palma-Rivas, 2000).

Most recently, researchers have argued that early studies may have failed to identify the more subtle aspects of learning that might take place, over time, in an online or distance environment, because by focusing simply on immediate test scores, they asked the wrong questions (Ehrmann, 2002). Recent studies have refined their assessment approach, considering outcomes such as long-term recall of material, and integration of new knowledge. Larger longitudinal studies have begun to reveal subtle but significant differences in learning outcomes. For example, Lehrer (1993) describes the development, use, and results of a hypermedia/multimedia construction tool called HyperAuthor that was used by eighth graders to design their own lessons on the subject of the American Civil War. The learners were asked to change information into dimensional representations, decide on the important issues, break information into nodes then link the information segments by semantic relationships, after deciding how to represent the ideas. Perkins (1993) argues that such a process is highly motivating for students because authorship results in “ownership” of the ideas in the multimedia presentation.

Students in the Lehrer study were both high and low ability eighth graders who worked at the multimedia construction tasks for one class period of 45 minutes per day over a period of several months to create programs reflecting their unique interests and individual differences. They used a Macintosh computer, scanner, sound digitizer, HyperAuthor software, and numerous print and non-print resources about the American Civil War. An instructor was also

available to coach students in the conceptualization, design, and production of the hypermedia programs.

According to Lehrer (1993), "The most striking finding was the degree of student involvement and engagement". Both high and low ability students became very task-oriented, increasingly so as they gained more autonomy and confidence with the cognitive tools. At the end of the study, students in the hypermedia group and a control group of students who had studied the Civil War via traditional classroom methods during the same period of time were given an identical teacher-constructed test of knowledge. No significant test differences were found. Lehrer conjectured that "these measures were not valid indicators of the extent of learning taking place in the hypermedia design groups, perhaps because much of what students developed in the design context was not anticipated by the classroom teacher".

A year later, however, when students in the design and control groups were interviewed, by an independent interviewer unconnected with the previous year's work, important differences was found. Students in the control group could recall almost nothing about the historical content, whereas students in the design group displayed elaborate concepts and ideas that they had extended to other areas of history. Most importantly, although students in the control group defined history as "the record of the facts of the past," students in the design class defined history as "a process of interpreting the past from different perspectives." In short, the "design approach lead to knowledge that was richer, better connected, and more applicable to subsequent learning and events".

Twigg (2001) and others have noted that few of the courses evaluated in early studies made significant improvements in either the cost or quality dimensions of student learning; instead, they frequently replicated the face-to-face pedagogies and organizational frameworks of

classroom teaching. Her seminal work, "Innovations in Online Learning: Moving Beyond No Significant Difference" explores new designs that build on the particular strengths of the Internet in order to improve traditional modes of instruction.

### **Student Assessment in Technology-Based Learning**

According to Carlson-Pickering (1999) educational technologies offer the additional benefit of allowing alternative assessments of what she calls "multiple intelligences". She notes, "If it is true that each of an individual's intelligences displays a set of psychological processes, it is important that these processes be assessed in an "intelligence-fair" manner. In contrast to traditional testing methods that merely measure achievement with a paper and pencil, a more fair measure would respect the different thinking, processing and performance modalities that may distinguish each intelligence. Standardized achievement tests may not measure the changes in students that educational reformers are looking for. Instead, they need to examine and refine new measures which are under development to assess areas that many teachers feel can be affected by the use of computers, such as higher order thinking skills, project conceptualization, effectiveness of presentation, technical qualities and originality to name a few".

She goes on to suggest that "...Educators who have already integrated technology successfully into their daily classroom experiences know how necessary it is to have alternative forms of assessment, which may be dramatically different than past methods of evaluation and/or standardized tests. Extra preparation time is devoted to the development of content-based rubrics for their ever-changing, technology-rich curriculum".

Carlson-Pickering argues that authentic assessment in a technology-rich educational environment requires a curriculum-based rubric that is student-specific. Echoing Perkins, she

suggests that successful curriculum units are those, which are developed not only by teachers, but by the students as well, because contribution to the development of the rubrics allows students to assume a sense of ownership. Students thus become more actively involved in the educational process and can more easily see the purpose of learning the designated skills. When these rubrics include technology standards and creativity (in addition to demonstrating a deep understanding of the content) students are encouraged to develop highly personalized interpretations that incorporate their strength intelligences (Carlson-Pickering, 1999).

### **Pedagogical Implications of the Use of Educational Technologies**

According to Böhm (1995), in the United States, "pedagogy" is assumed to have a very narrow meaning. If it is used at all, it usually refers to the techniques or methods of teaching in formal educational institutions. Graduate students enroll in education courses, rather than courses in pedagogy. Educational philosophy is often seen as something far removed from pedagogy, and typically far removed from the actual day-to-day requirements of teaching and, therefore, of proper teacher preparation. But "pedagogy" in the United States (and Canada) was not always limited to this narrow perspective. It once referred to the academic discipline, which examined the purposes, goals, perspectives, techniques, and practices of education within their philosophical and historical contexts.

The National Board for Professional Teaching Standards (1998) defines content pedagogy as “the pedagogical (teaching) skill teachers use to impart the specialized knowledge/content of their subject area(s)”. It states that effective teachers display a wide range of skills and abilities that lead to creating a learning environment where all students feel comfortable and are sure that they can succeed both academically and personally.

As Twigg (1994) notes, however, our current system of teaching and learning is changing as "...institutions respond to the changing definition of learning". This author goes as far as to suggest that information and communication technologies are actually central drivers of change in teaching and learning, by making it possible for us to think about new ways of responding to new demands. Indeed, the lack of affordable, widely available information technology may be the primary reason why we have not seen significant changes in our methods of teaching and learning until recently. For example, even though distance learning has been around for a long time – primarily in the form of correspondence study – the existence of affordable information technology with the capability of offering instruction anytime, to anyone, anywhere has given new impetus to the changes regarding who, when, and where students learn. Significantly, what we know (and don't know) about the ways students learn is converging with new multimedia capabilities. Others caution, meanwhile, that the simple appearance of technological wonders and their use in the field of education cannot automatically be regarded as pedagogical innovation (Korös-Mikis, 2001).

### **Changing Roles for Teachers**

An education process that advocates students as a central focus, changes the teacher's role to one of "facilitator, guide, and coach" (Smith, 1997). It places emphasis on students as active contributor to the process of finding, organizing, analyzing, and applying knowledge in fresh ways to solve problems. Students become part of a learning community where they collaborate to discover information from a variety of sources, including peers, teachers, experts, real-world data, simulations, and experiences.

Carlson-Pickering (1999) believes that both teachers and students are finding technology-supported activities to be a stimulating part of their daily lessons. The enthusiasm Carlson-

Pickering observed in teachers and their students, as they explored the options technology has to offer, amazed her. She reports: “The saying ‘You can't teach an old dog new tricks’ definitely does not apply to technology for I have witnessed the excitement in the eyes of veteran teachers, as they become proficient in this area. Technology's captivating qualities lure students and teachers alike.” It appears that everyone seems to find an area within (an intelligence/talent perhaps) that becomes activated with computer integration. She credits these changes with triggering a number of positive effects within the classroom:

- A shift from classroom lectures to computer networked access to educational resources, giving students more control over their educational experiences
- A shift from student as a passive recipient of education to a self-directed student learning
- A shift from individual learning to team learning and group work and discussion
- A shift towards new forms of creative and artistic expression
- A shift towards a fully integrated digital curriculum

### **Community and Collaboration**

Taking learning beyond the classroom and into the online environment presents a real challenge to teachers in schools today. In particular, it confronts the much-quoted isolating effect of computer-mediated education on students. Thus, a core challenge of online teaching is the development of a sense of community among learners and associated forms of collaboration and support (Follansbee et al., 1997).

The Internet, Pringle (2002) notes, has quickly become a ubiquitous open web of interconnected, global computer networks (McIntyre & Wolff, 1998), allowing for extensive interaction and collaboration among learning communities. The concept of building "communities of learners" is based on democratic ideals of learning processes and products

(Schon, 1999). According to Roth (1998), such communities are built on principles of co-participation while challenging traditional modes of teacher-student relationships. Here, co-participation implies the presence of a shared language that is acquired by all participants as they engage in the activities of the community with a goal of facilitating meaningful learning. In effect, the teachers are no longer the bearers of information, but partners in conversations that seek to construct knowledge. This construction process occurs through negotiation and consensus building, allowing the viability of such knowledge to be tested against what has been established and accepted as "truth."

Follansbee et al. (1997) point out that teachers also need to feel part of a community of discovery and support, and highlights the complexity of the task of translating and transforming the attitudes and skills of teachers in order to master what has been called a new 'electronic pedagogy'. This author suggests that proliferation of online facilities in schools makes it imperative to encourage informed debate about troublesome online educational issues. Without the collating of experiences and a debate about the issues, greater uncertainty in school environments will emerge (Follansbee et al., 1997).

The community of learning, as a teaching and learning tool, offers potential for significant change in education. First, it has implications for the emerging role of the instructor. Larochelle & Bednarz (1998) propose that the facilitating role of the teacher now includes the rethinking of how the students might render the knowledge visible to themselves and to other members within their learning community. The focus is now on interaction and co-participation with the goal of facilitating the emergence and sharing of a type of socio-discursive cohesion within the given community. Such a radical change in approach can be problematic, as much of schooling has been focused on competition, individual achievement and the ability of learners to

reproduce the knowledge garnered from the teacher or texts. This orientation usually requires the meeting of specific standards or criteria established by some authority, such as a testing organization.

In the new social context that an online learning community affords, not only will instructors have to cultivate a sense of community among learners; they will have to help them reconstruct the idea of what it means to know and to appreciate the process of knowledge building.

Instructors will have to facilitate the development of trust among learners and a respect for timeliness of posting, a sense of community among learners, and a move away from traditional competitive strategies for achievement. This will require instructors to develop their own strategies and skills not embraced in traditional teaching.

### **Skills and Practices of Effective/ Successful Online Teachers**

The Department of Employment, Education, Training and Youth Affairs (1996), Australia, provides an excellent summary of the prerequisites for fostering successful learning using technology (both in the classroom and by distance). This report concludes, “IT (Information Technology) can only contribute substantially to the improvement of schooling if it is appropriately embedded in powerful and interactive learning environments”. In their view, such environments are characterized by:

- a good balance of discovery learning and personal exploration on the one hand, and systematic teaching and guidance on the other
- the taking into account of individual differences in abilities, needs, and motivation between students
- the provision of explicit links to the learner's prior knowledge and skills
- cooperative learning activities through the appropriate use of small groups

- situations and tools that stimulate students to make maximum use of their own cognitive potential
- strategies that enable students to take control of their learning
- teaching strategies that show students how to transfer skills between domains
- opportunities for contact with and observation of experts
- just-in-time learning – students and teachers accessing information and learning resources when and where they need them.

Coghlan (2002) offers a list of skills that he considers necessary, basic and important for the teacher engaged in teaching with technology. These include:

- familiarity and facility with Internet environment including using a browser, email, using attachments and downloading files
- familiarity and facility with any delivery platform used on the course
- prior online experience (as a student or teacher, if possible)
- enjoyment of the technology and not being ‘put off’ by technology problems
- having the time to teach this way (as it is time consuming)
- good written communication skills and ability to communicate in plain language
- good knowledge of content

### **Implementing and Integrating Technology in the Classroom**

The Apple Classroom of Tomorrow (ACOT) Project (Fisher et al., 1996) illustrates the enormous importance of the implementation *process* in efforts to infuse media and technology into classroom practice. In 1985, Apple Computer, Inc., began a long-term collaboration with several widely separated school districts around the USA. Students and teachers were provided

with computers and software for both school and home use, and research has been conducted in the participating schools for over a decade.

Some of the most interesting findings from the ACOT research relate to teachers and the implementation process. ACOT researchers found that teachers had strong beliefs about their roles and efficacy as teachers, beliefs that changed very slowly as their classrooms moved toward child-centered rather than textbook-driven education (Sandholtz & Ringstaff, 1996). Teachers had to make significant changes in their classroom management styles, giving up more control to technology and students. This also occurred slowly.

Initially, media and technology were used primarily within the context of traditional pedagogical methods, and most teachers required years of experience before they adopted more innovative strategies such as project-based learning. Finally, teachers struggled with fundamental incongruities between traditional assessment measures and those required by the new kinds of learning occurring in their classrooms. In fact, assessment problems proved to be the most resistant to solutions and many remained unresolved (David, 1996).

The bottom line of the ACOT Project is that pedagogical innovations and positive learning results do eventually emerge from the infusion of media and technology into schools, but the process takes longer than most people imagine. “Educational administrators who imagine that a summer workshop or in service seminar by consultants will sufficiently enable teachers to implement media and technology in their classrooms are mistaken. Significant investments in time and support for teachers will be especially critical if the adoption of constructivist pedagogies are to accompany the infusion of media and technology” (Duffy & Cunningham, 1996).

## **Uses of Technology in Specific Content Areas**

Reports dating from the mid-1990s have detailed the successful uses of technology in almost every dimension of school-based and adult learning. While most early practice and research focused on the areas of technology, mathematics and science, use of ICTs in other content areas has flourished in recent years. A summary work on the Apple K-12 effectiveness projects examined the effectiveness of technology in language arts, math, science, reading and writing, social studies, management and administration, and also the preparation of students for the workplace, and is a useful online resource for teachers and educational administrators (Advanced Technology Group, 1997).

Similarly, the Australian Professional Development Program report entitled “Computers Across the Secondary Curriculum” (1996) summarizes successes and challenges of technology integration in key learning areas including literacy, mathematics, science, languages, performing arts, technology and art. Of particular interest may be these authors review of technology applications for students with special needs, and the utility of technology for promoting access to communication, development of literacy and numeracy, and collaborative working for these students. Ungerleider & Burns (2002) also present a critical review of studies examining the application of ICTs in teaching and learning K-12 Reading Writing and Spelling, Art, History/Social Studies, Mathematics, Sciences and Geography.

Others (Cifuentes, Murphy, & Trina, 1998; Stacey, Goodman & Stubbs, 1996; Cena, 2000) have reported that educational technologies can successfully be used to promote multicultural understanding and intercultural communications skills in school-age students. One case study (Cifuentes et al., 1998) focused on the effects of collaborative activities between two teachers and their students. The authors explored the effectiveness of distance learning for

adolescents in promoting self-esteem, achievement, and multicultural understanding. These authors report that in networked classrooms, students connected with distant others to learn about their perspectives and increased their multicultural understanding. Four overarching themes emerged from the study: growth, empowerment, comfort with technology, and mentorship. In addition, distance technologies fostered team teaching across cultures and geographical distances.

While there is little literature available concerning *inappropriateness* of technology for curriculum content areas, there appears to be a difference of opinion on the utility of technology in support of foreign language learning. In his comprehensive study on technology effectiveness in K-12 learning, Cavanaugh (2001) found that foreign language learning was the only content area in which technology use did not significantly improve learning outcomes. On the other hand, and in spite of reported challenges, the report of the Australian Professional Development Project described above discusses a range of ways in which technology can be used to effectively support language learning.

Glisan, Dudt, & Howe (1998) also reported increases in Spanish language learning achievement in a pilot study where elementary school students learned Spanish using videoconferencing. Shih & Cifuentes (2000) describe a successful online English-as-a-Second-Language collaborative learning project, while Lee (1999) gives a comprehensive discussion of the utility of educational technologies for language learning, and also gives a detailed analysis of technical approaches and adaptations for language teaching.

From basic skills in writing (Krause, 1995), to the humanities (Hussein, 2002) and sciences (Alick, 1999, Brown & Edelson, 1999), to new language learning and intercultural experiences, to teacher training (McCallum, McGrath & Rusch, 1997), the Internet, web-based

learning and technology are being considered and used at all levels of K-12, post-secondary and life-long learning.

### **The Outlook for Teachers and Educational Technology**

Teaching remains a labour intensive activity, and teachers remain central in the processes of pedagogical change and innovation. Online technologies can, at the least, supplement what teachers do and, at best, transform and inspire what they do and what is possible for their students to achieve.

However, the online world comes with many pieces of software and hardware, new protocols and a myriad of administrative hassles. In addition, students sometimes know more about the specific technologies than their teachers. It remains tempting, though potentially debilitating, for teachers to privatize anxieties about the uses of technology in teaching and learning. Sticking to classroom methods that work and avoiding the risks and complications of technology usage, may be necessary for some teachers. Yet a number of reports have shown that, whatever the level of technological competence or experience, it becomes possible for teachers to become effective with an ‘online pedagogy’, given only limited but guided engagement with the technology, with some time to reflect on the process, if there is an openness on the part of the teacher, to let students be part of the process and finally and perhaps most importantly, with support from mentors in the field.

What is critical is that forms of mentoring and peer support are enabled among teachers who understand a particular field of learning so that the educational goals and concerns of the discipline remain central to the professional development strategies related to online teaching and learning.



## Conclusions

In summary, this part of our Literature Review incorporates both positive and cautionary results about the emerging field of online learning. Overall, the current literature is optimistic about the current and potential benefits of online learning experiences for students while simultaneously identifying new areas of teacher responsibility, skill development and creativity.

A sample of results includes the following:

- Students with online experience receive significantly higher scores on measurements of information management, communication, and presentation of ideas.
- The Internet helps students becoming independent, critical thinkers, able to find information, organize and evaluate it, and then express new knowledge and ideas in compelling ways.
- Online learning provides valuable access to current ‘real world’ information for use in projects and assignments.
- Internet-based learning activities can make reading more enjoyable, fostering use of critical reading skills, and promoting reading fluency.
- Teacher attitudes to technology are critical to student success in the online learning environment.
- Group interaction online requires guidance and facilitation, and encouragement of social skill development.
- Some students can feel isolated due to decreased personal contact with teachers and classmates
- Teachers need to provide clear instructions for tasks and specific guidelines for interactions.

- Students require guidance and support in identifying conflicting or inaccurate information.
- Involving students in the design of their learning tasks can result in knowledge that is richer, better connected, and more applicable to subsequent learning.

The ongoing challenges for schools, researchers and educators will be to ensure that students acquire the skills to become “techno-literate”, and to continue to investigate the ways that existing and new technologies can best enhance and facilitate learning, enquiry and motivation. Teachers, in particular, must continue to take risks, try new techniques, and explore new technologies, “for through these actions, they will turn a child's talents along with his passion for learning into a powerful, creative force” (Carlson-Pickering, 1999).

## **Acknowledgements**

This review forms part of a contracted three-phase evaluative study of K-12 e-learning, undertaken between May 2002 and June 2003 by the MAPLE Centre (part of Distance Education and Technology, Continuing Studies, The University of British Columbia) for the Inukshuk Consortium “Doing IT Right” Project. This K-12 e-learning project was funded by the Inukshuk Fund and was implemented by a partnership of K-12 educators in British Columbia, Canada, namely “Cool School” (a consortium of twelve School Districts), a consortium of nine Provincial Distance Education Schools (39, 8, 33, 63, 71, 60, 57, 82, 58), the Surrey School District (36), and the Vancouver School Board (39). For information on the Inukshuk e-learning initiative, please contact the authors.

## Bibliography

- Advanced Technology Group. (1997). *Apple K-12 effectiveness reports*. Retrieved July 12<sup>th</sup>, 2002 from: <http://www.apple.com/education/k12/leadership/effect.html>
- Alberta Education. (1999). *Funding Manual for 1998-1999*. Retrieved August 20<sup>th</sup>, 2002 from <http://ednet.edc.govb.ab.ca/>
- Alick, D. (1999). *Integrating multimedia and multiple intelligences to ensure quality learning in a high school biology classroom*. Retrieved July 12<sup>th</sup>, 2002 from <http://www.angelfire.com/de2/dalick/researchMI.htm>
- Australian Professional Development Program. (1996). *Computers across the secondary curriculum – Research reviews*. Retrieved July 12<sup>th</sup>, 2002 from <http://www.sofweb.vic.edu.au/lt/casc.htm>
- Baker, E. A. (2000). Instructional approaches used to integrate literacy and technology. *Reading Online*, 4(1). Retrieved July 12<sup>th</sup>, 2002 from <http://www.readingonline.org/articles/baker>
- Bales, J. (2001) What's in a MOO for primary students' online learning? *E-Journal of Instructional Science and Technology*, 6 (1). Retrieved August 1<sup>st</sup>, 2002 from [http://www.usq.edu.au/electpub/e-jist/docs/Vol6No\\_1/bales.html](http://www.usq.edu.au/electpub/e-jist/docs/Vol6No_1/bales.html)
- Barker, K, Wendel, T., & Richmond, M. (1999). *Linking the literature: School effectiveness and virtual schools*. Report prepared for the Society for the Advancement of Excellence in Education. Retrieved August 1<sup>st</sup>, 2002 from <http://www.futured.com>
- Barker, K., & Wendel, T. (2001). e-Learning: Studying Canada's virtual secondary schools. *SAEE Research Series #8*. Retrieved August 1<sup>st</sup>, 2002 from <http://www.sae.ca>
- Böhm, W. (1995). *Theory, practice and the education of the person*. Washington, DC: OEA/Colección INTERAMER #41.

- Bracewell, R., & Laferriere, T. (1996). *The contribution of new technologies to learning and teaching in elementary and secondary schools*. Retrieved August 1<sup>st</sup>, 2002 from <http://www.fse.ulaval.ca/fac/tact/fr/html/apport/impact96.html>
- Brophy, S., Biswas, G., Katzlberger, T., Bransford, J., & Schwartz, D. (1999). Teachable agents: Combining insights from learning theory and computer science. In *Proceedings, AI-ED 99, LeMans, France*. Retrieved August 1<sup>st</sup>, 2002 from <http://www.vuse.vanderbilt.edu/~vxx/ta/aied99.pdf>
- Brown, M., & Edelson, D. C. (1999). *A lab by any other name: Integrating traditional labs and computer-supported collaborative investigations in science classrooms*. Retrieved August 1<sup>st</sup>, 2002 from [http://www.letus.org/PDF/MB\\_DCE\\_CSCL99ALAB.pdf](http://www.letus.org/PDF/MB_DCE_CSCL99ALAB.pdf)
- Buckley, B. C., Gobert, J. D., & Christie, M. T. (2002). Model-based teaching and learning with hypermodels: What do they learn? How do they learn? How do we know? *Proceedings, Hypermodel Research in Theory and Practice Symposium, American Educational Research Association, New Orleans, April 2002*. Retrieved August 1<sup>st</sup>, 2002 from <http://www.concord.org/publications/detail/hypermodels-4-2002.html>
- Carlson-Pickering, J. (1999). *MI & Technology: A Winning Combination!* Rhode Island Teachers in Technology Initiative. Retrieved August 20<sup>th</sup>, 2002 from [http://www.ri.net/RITTI\\_Fellows/Carlson-Pickering/MI\\_Tech.htm](http://www.ri.net/RITTI_Fellows/Carlson-Pickering/MI_Tech.htm)
- Cavanaugh, C. S. (2001). The effectiveness of interactive distance education technologies in K-12 learning: A meta-Analysis. *International Journal of Interactive Telecommunications*, 7 (1), 73-88.

- Cena, J. E. (2000). Bridging gaps between cultures, classrooms and schools: A close look at online collaborative learning. *Educational Technology & Society*, 3 (3). Retrieved August 15<sup>th</sup>, 2002 from [http://ifets.ieee.org/periodical/vol\\_3\\_2000/d01.pdf](http://ifets.ieee.org/periodical/vol_3_2000/d01.pdf)
- Cifuentes, L., Murphy, K., & Trina, D. (1998) Cultural connections: Promoting self-esteem, achievement, and multicultural understanding through distance learning. *Proceedings of Selected Research and Development Presentations at the National Convention of the Association for Educational Communications and Technology (AECT) Sponsored by the Research and Theory Division (20th, St. Louis, MO, February 18-22, 1998)*. Retrieved August 15<sup>th</sup>, 2002 from <http://www.edrs.com/Webstore/Download.cfm?ID=439246&CFID=1910601&CFTOKEN=2815542>
- Clarke, D. (1999). *Getting results with distance education*. University of California at Santa Cruz, Unpublished. Contact author at [dclarke@ucsc-extension.edu](mailto:dclarke@ucsc-extension.edu). Work noted in *The American Journal of Distance Education*, 12 (1), 38-51.
- Clark, T. (2001) *Virtual schools: Trends and issues*. Report for the Distance Learning Resource Network. Retrieved August 15<sup>th</sup>, 2002 from <http://www.wested.org/cs/wew/view/rs/610>
- Coghlan, M. (2002). *Prerequisite skills for online learners*. Retrieved August 15<sup>th</sup>, 2002 from <http://users.chariot.net.au/~michaelc/olfac.html#students>
- Coley, R. J., Cradler, J., & Engel, P. K. (1997). *Computers and classrooms: The status of technology in U.S. schools (Policy Information Report)*. Princeton, NJ: Educational Testing Service.
- Council of Ministers of Education, Canada (CMEC). (1997). *Developments in information technologies in education*. Toronto: Council of Ministers of Education, Canada.

- David, J. L. (1996). Developing and spreading accomplished teaching: Policy lessons from a unique partnership. In C. Fisher, D. C. Dwyer, & K. Yocam (Eds.), *Education and technology: Reflections on computing in the classroom* (pp. 237-250). San Francisco, CA: Jossey-Bass.
- Department of Employment, Education, Training and Youth Affairs Australia (DEETYA). (1996). *Gateways: Information technology in the learning process*. Canberra, AGPS. Retrieved August 15<sup>th</sup>, 2002 from <http://www.edna.edu.au/sibling/learnit/index.html>
- Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170-198). New York: Macmillan.
- Ehrmann, S.C. (2002). *Asking the right question: What does research tell us about technology and higher learning?* Retrieved August 15<sup>th</sup>, 2002 from <http://www.learner.org/edtech/rscheval/rightquestion.html>
- Fisher, C., Dwyer, D. C., & Yocam, K. (Eds.). (1996). *Education and technology: Reflections on computing in the classroom*. San Francisco, CA: Jossey-Bass.
- Follansbee, S., Hughes, R., Pisha, B., & Stahl, S. (1997). The role of online communications in schools: A national study. *ERS Spectrum*, 15(1), 15-26.
- Forman, D. C. (1987). The use of multimedia technology for training in business and industry. *Multimedia Monitor* 13, 22-27.
- Franklin, U. (1990) *The real world of technology: The 1989 Massey Lectures*. Toronto: CBC Enterprises.
- Glisan, G. W., Dudt, K. P., & Howe, M. S. (1998) Teaching Spanish through distance education: Implications of a pilot study. *Foreign Language Annals*, 31(1), 49-66.

- Haddad, W. D., & Draxler, A. (2002). *Technologies for education: Potentials, parameters and prospects*. Prepared for UNESCO by Knowledge Enterprise Inc. Retrieved August 15<sup>th</sup>, 2002 from <http://www.Knowledgeenterprise.org>
- Hussein, S. (2002). What's Your problem? Web-enhancement in the humanities classroom. *The Technology Source* (July/August). Retrieved August 15<sup>th</sup>, 2002 from <http://ts.mivu.org/default.asp?show=article&id=931>
- Johnson, S. D., Aragon, S. R., Shaik, N., & Palma-Rivas, N. (2000). Comparative analysis of learner satisfaction and learning outcomes in online and face-to-face learning environments. *Journal of Interactive Learning Research*, 11(1), 29-49.
- Kearsley, G. (2000). *Learning and teaching in cyberspace*. Retrieved August 15<sup>th</sup>, 2002 from <http://home.sprynet.com/~gkearsley/chapts.htm#chap5>
- Korös-Mikis, M. (2001). Defining innovative pedagogical practice by LOGO-educators. National Institute of Public Education. Retrieved August 10<sup>th</sup>, 2002 from <http://www.ocg.at/activities/books/volumes/band%20156/P63koros.doc>
- Koszalska, T. A., & Wang, X. (2002). Integrating technology into learning: a summary of promises and problems. *Educational Technology & Society*, 5(1). Retrieved August 10<sup>th</sup>, 2002 from [http://ifets.ieee.org/periodical/vol\\_1\\_2002/koszalska.html](http://ifets.ieee.org/periodical/vol_1_2002/koszalska.html)
- Krause, S. (1995). "How will this improve student writing?" Reflections on an exploratory study of online and off-line texts. *Computer-Mediated Communication Magazine*, 2(5), 10. Retrieved August 10<sup>th</sup>, 2002 from <http://www.ibiblio.org/cmc/mag/1995/may/krause.html>
- Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Educational Technology & Society*, 5(1). Retrieved August 10<sup>th</sup>, 2002 from [http://ifets.ieee.org/periodical/vol\\_1\\_2002/kreijns.pdf](http://ifets.ieee.org/periodical/vol_1_2002/kreijns.pdf)

- Larochelle, M., & Bednarz, N. (1998). Constructivism and education: Beyond epistemological correctness. In M. Larochelle, N. Bednarz & J. Garrison (Eds.). *Constructivism and education* (pp. 1-20). Cambridge, UK: Cambridge University Press.
- Lee, C-H. (1999). An exploration of pedagogical implications of using networked-based computer mediated communication in the communicative language classroom. *Interpersonal Computing and Technology*, 7 (1-2). Retrieved August 10<sup>th</sup>, 2002 from <http://jan.ucc.nau.edu/~ipct-j/1999/n1-2/Lee.html>
- Lehrer, R. (1993). Authors of knowledge: Patterns of hypermedia design. In S. P. Lajoie & S. J. Derry (Eds.), *Computers as cognitive tools* (pp. 197-227). Hillsdale, NJ: Lawrence Erlbaum.
- Litke, D. (1998). Virtual schooling at the middle grades: A case study. *Journal of Distance Education*, 13.2. Retrieved August 10<sup>th</sup>, 2002 from <http://cade.icaap.org/vol13.2/litke.html>
- McCallum, R. D., McGrath, O. G., & Rusch, J. B. (1997). Instructional applications of Internet technology: Teacher training in the language and literacy MOO. *Reading Online*. Retrieved August 10<sup>th</sup>, 2002 from <http://www.readingonline.org/electronic/moo/index.html>
- Macfadyen, L. P., Janes, D. P. and Hawkes, B. (2003). K-12 teachers and learners in an electronic world: A review of the literature. Part II: Learner issues in ICT-mediated learning. (Submitted March 24<sup>th</sup>, 2003 to the *Canadian Journal of Learning and Technology*).
- McIntyre, D., & Wolff, F. (1998). An experiment with WWW interactive learning in university education. *Computers and Education*, 31, 255-264.
- McNabb, M. L., Hassel, B., & Steiner, L. (2002). Literacy learning on the net: An exploratory study. *Reading Online*, 5(10). Retrieved August 10<sup>th</sup>, 2002 from [http://www.readingonline.org/articles/art\\_index.asp?HREF=/articles/mcnabb/index.html](http://www.readingonline.org/articles/art_index.asp?HREF=/articles/mcnabb/index.html)

National Board for Professional Teaching Standards. (1998). Washington, DC: Author.

Retrieved August 10<sup>th</sup>, 2002 from <http://www.nbpts.org/>

National Foundation for the Improvement of Education (USA). (2000). *Connecting the bits: A reference for using technology in teaching and learning in K-12 schools*. Washington, DC:

Author. Retrieved August 10<sup>th</sup>, 2002 from <http://www.nfie.org/publications/connecting.htm>

Noble, D. F. (2002). *Digital diploma mills: The automation of higher education*. Toronto:

Between the Lines.

Perkins, D. N. (1993). Person-plus: A distributed view of thinking and learning. In G. Salomon

(Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 88-110).

Cambridge, UK: Cambridge University Press.

Postman, N. (1993). *Technopoly: The surrender of culture to technology*. Toronto: Vintage

Books.

Pringle, R. M. (2002). Developing a community of learners: Potentials and possibilities in web

mediated discourse. *Contemporary Issues in Technology and Teacher Education*, 2(2).

Retrieved August 11<sup>th</sup>, 2002 from

<http://www.citejournal.org/vol2/iss2/currentpractice/article2.cfm>

Rifkin, J. (2001). *The age of access: The new life of hyper-capitalism where all life is a paid-for experience*. London: Tarcher/Putnam.

Roth, W-M. (1998). *Designing communities*. Dordrecht: Kluwer Academic.

- Russell, T. L. (1999). *The no significant difference phenomenon: A comparative research annotated bibliography on technology for distance*. Raleigh, NC: North Carolina State University. Selected entries retrieved August 16<sup>th</sup>, 2002 from <http://teleeducation.nb.ca/nosignificantdifference/>
- Sandholtz, J. H., & Ringstaff, C. (1996). Teacher change in technology-rich classrooms. In C. Fisher, D. C. Dwyer, & K. Yocam (Eds.), *Education and technology: Reflections on computing in the classroom* (pp. 281-299). San Francisco, CA: Jossey-Bass.
- Schon, D. (1999). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco, CA: Jossey-Bass.
- Shih, Y.-C. D., & Cifuentes, L. (2000). Online ESL learning: An authentic contact. *Proceedings, International Conference on Computers in Education/International Conference on Computer-Assisted Instruction (8th, Taipei, Taiwan, November 21-24, 2000)*. Retrieved August 11<sup>th</sup>, 2002 from <http://cslsrv.ice.ntnu.edu.tw/icce/Proceedings/F1069.pdf>
- Smeaton, A., & Keogh, G. (1999). An analysis of the use of virtual delivery of undergraduate lectures. *Computers and Education*, 32, 83-94.
- Smith, K. L. (1997). Preparing faculty for instructional technology: From education to development to creative independence. *CAUSE/EFFECT*, 30(3), 36-44, 48.
- Southwest Educational Development Laboratory. (1999). *Connecting student learning and technology*. Retrieved August 11<sup>th</sup>, 2002 from <http://www.sedl.org/pubs/tec26/flash.html>

- Stacey, D., Goodman, S., & Stubbs, T. D. (1996). The new distance learning: Students, teachers and texts in cross-cultural electronic communication. *Computers and Composition*, 13(3), 293-302.
- Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York: McGraw-Hill.
- Trinkle, D. A. (1999). Distance education: A means to an end, no more, no less. *The Chronicle of Higher Education*, August 6, A60.
- Twigg, C. A. (1994). The changing definition of learning. *Educom Review*, 29 (4). Retrieved August 11<sup>th</sup>, 2002 from <http://www.educause.edu/pub/er/review/reviewArticles/29422.html>
- Twigg, C. A. (2001). *Innovations in online learning: Moving beyond no significant difference*. Troy, NY: The Pew Learning and Technology Program. Retrieved August 11<sup>th</sup>, 2002 from <http://www.center.rpi.edu/PewSym/Mono4.html>
- Ungerleider, C. S., & Burns, T. C. (2002). Information and communication technologies in elementary and secondary education: A state of the art review. *Proceedings, Pan-Canadian Education Research Agenda Symposium on "Information Technology and Learning"*, April 30 – May 2, 2002, Montréal, Quebec. Retrieved December 5<sup>th</sup>, 2002 from [http://www.cmec.ca/stats/pcera/RSEvents02/CUngerleider\\_OEN.pdf](http://www.cmec.ca/stats/pcera/RSEvents02/CUngerleider_OEN.pdf)
- Wade, W. (1999). Assessment in distance learning: What do students know and how do we know that they know it? *T.H.E. Journal*, 27(3), 94-100.
- Web-Based Education Commission (USA). (2000). *The power of the Internet for learning: Moving from promise to practice*. Report Prepared for the President and Congress of the

USA. Washington, DC: Author. Retrieved August 11<sup>th</sup>, 2002 from

<http://www.webcommission.org>

Wishart, J., & Blease, D. (1999). Theories underlying perceived changes in teaching and learning after installing a computer network in a secondary school. *British Journal of Educational Technology*, 30(1), 25-42.