
II

CURRENT PRACTICES AND BENEFITS OF USING ICT IN EDUCATION IN DEVELOPED COUNTRIES

Information and communications technology is dramatically and rapidly transforming secondary and post-secondary education in developed nations to a degree scarcely imaginable only one generation ago. High schools, colleges, vocational schools, universities, and advanced research institutions are being profoundly affected, at all levels and in myriad respects.

In particular, ICT has affected distance learning (DL) or distance education (DE), allowing school calendars to be designed to accommodate the needs of individual students on one hand and faculty on the other, thus moving many elements of the educational process into the virtual world. This hugely increases the “market” of potential learners. Such technology-mediated instruction can be accessed 24 hours a day, 7 days a week from almost any location, opening opportunities for working students, parents of young children, and those with disabilities to reach their educational goals. Moore (2001) relates that the advent of interactive media and flexible scheduling has brought forth a new generation of distance faculty, who are now able to teach while pursuing other interests. Moore (2001) and Brown (1999) report that reaching a wider audience is a strong motivator for translating coursework into electronic formats. Faculties, often apprehensive that a class may be cancelled due to lack of enrollment, are seeking ways to cast a “wider net.”

In other words, ICT is changing the developed world’s attitudes and approaches to education. By transcending traditional physical

and spatial constraints, ICT brings to millions of people of all ages, ethnic groups, and socio-economic levels unprecedented educational opportunities—whether they are on campus or off, attending vocational institutions, or receiving technical education and vocational training (TEVT) at a distance; whether they are fully or partially employed; whether or not they are physically disadvantaged; and whether they live in dense urban agglomerates or in remote and rural communities. In terms of access, ICT, properly utilized, promises the ultimate democratization of education.

Further, it is able to do this in a cost-effective, sustainable way. Generally speaking, the more learners participating in a technology-mediated program, the lower the per-student cost. Historically, there has been an inverse relationship between technological capability and cost.

The following sections in this chapter provide an overview of current practices and benefits of ICT applications in education and training in developed countries.

A. Teacher and Student Attitudes and Behavior

Teachers

Relatively little is known about what motivates a teacher to adopt ICTs in a classroom. Indeed, for some, the prospect of changing from the role of lecturer to that of combined mentor, guide, and motivator (even entertainer!) can be daunting, implying a diminution of authority or a slight fading of their perceived image of infallibility. Nonetheless, throughout the developed world over the past 20 years the great majority of teachers appear eager to adopt ICTs when appropriate opportunities arise.

A 2002 study examining the changes in pre-service and in-service attitudes of teachers toward computers indicated that teacher' attitudes, levels of confidence, and job satisfaction significantly improved after completing a computer literacy course. The follow-up study indicated that previous computer experience had a very positive influence upon teachers' expectations of the course. Teachers reported that having a home computer, a supportive and effective professor/

Best Practice: The Connected Campus

A new, all-inclusive vision for the future: Several years ago, the president of Acadia University, a small public institution in Wolfville, Nova Scotia, Canada, conceived of an integrated, fully wired learning environment allowing 24/7 access to educational resources by both students and teachers, while encouraging academic innovation along with effective technological applications in the classroom. The university administration embarked on a mission to equip Acadia's students and faculty with anytime, anywhere access to educational services.

Today, that vision, called Acadia Advantage, has been realized. Acadia is now the most "wired" campus in North America, and perhaps the world. Each of the university's 4,000 students, as well as its faculty and administrative employees, has a notebook computer, enabling them to advance their computing skills while tapping into a world of learning resources. Highly qualified students from all over the world now attend Acadia, and the university's international enrollment has nearly tripled. Acadia's focus on technology has resulted in an exceptional record of academic innovation. Research shows that the use of course management tools has increased to nearly 65% at Acadia. The university was identified by the Smithsonian Institute for inclusion in its permanent collection as one of the world's leading examples of the application of information technology to the learning environment.^a

One of the most interesting aspects of Acadia's achievement is the manner and extent to which the faculty and other teaching staff "bought-in" to the concept. Senior administrators placed high priority on earning faculty acceptance by providing both adequate and appropriate technology as well as frequent demonstrations and workshops as systems became available and "online." Over a 5-year period, the program earned strong support from faculty members, who frequently were "chomping at the bit" for more.

(continued)

^a For more information, see: <http://www.acadiau.ca/advantage/aboutaa/whatisaa.html>.

Best Practice: The Connected Campus (continued)

It was recognized that the long-term success of such a radically new approach would require significant and sustained investment in professional development and support. As a result, Acadia created the Acadia Institute for Teaching & Technology (AITT), with the mandate (and resources) to keep abreast of technological and pedagogical advances worldwide in the application of ICT in post-elementary education, and to develop state-of-the-art courses and upgrading opportunities for Acadia teaching staff and educators-to-be on a continuing and freely accessible basis. AITT has become a critical component of the Acadia Advantage. To date it has produced more than 1400 ICT-competent teachers. The benefits, for teachers (according to both the teachers themselves and/or outside evaluators) include

- Improved computer skills and higher comfort-levels with technology,
- Improved ability to work successfully in groups,
- Enhanced communications skills, and
- Improved problem-solving capabilities.

Benefits to the university as a whole in terms of communications infrastructure include:

- All classrooms include data projectors, docking stations with network access, videocassette recorders (VCRs), speakers, and full screens.
- Each student station in more than 35 classrooms has access to the Internet, to each other in the class, and to everyone on campus.
- Every student has immediate, 24/7, access to myriad educational resources—the Internet, course materials, and library resources, for example—from anywhere, on or off campus, throughout their stay at Acadia.

instructor, and an appropriate level of ICT in the schools at which they work also influenced their attitudes toward, and use of, computers.³

A recent survey by the National Education Association reports that 63% of America's college instructors develop and teach distance courses in the absence of any financial incentives to do so.⁴ Similarly, in the absence of any explicit, system-wide ICT policy, a growing number of universities make ad hoc use of ICTs in their curricula, through online courses and distance education. Brown (1999) and Betts (1998) point out that many colleges are offering development support through non-traditional, ICT-related means. Distributed Learning departments are providing instructional and graphic design support to share and distribute the educators' workload while instructional technology staff often assist with technical questions. In short, whether as a result of deliberate institutional policy or more ad hoc individual initiative, teachers everywhere in the developed world have increasingly recognized over the past 20-plus years the potential of ICT in the educational process and embraced it, bringing benefits to both teachers and students.

Students

Although the term ICT implies far more than simply access to personal computers, students generally perceive using computers as having a positive effect on their learning.⁵ On average, students who used computer-based instruction scored at the 64th percentile on tests of achievement, compared to students in controlled conditions without computers who scored at the 50th percentile.⁶ Reinforcing the claims of earlier empirical studies, it has been found that using computer technologies in developmental classrooms positively influenced students' attitudes toward writing and improved both the appearance and quantity of student writing.⁷ According to extensive research,⁸ students strongly favor the use of computer-based presentations:

³ See Yildirim (2000).

⁴ See National Education Association (2000).

⁵ See Lui, Macmillan, and Timmons (1999).

⁶ See Kulik (1994).

⁷ See the discussion on AutoSkill in section on Assessment and Monitoring in this chapters.

⁸ See Mayer and Coleman (2000).

- 95% of students surveyed said that instructional technology made lectures more interesting or much more interesting.
- 94% said that the technology made note taking easier or much easier. Most importantly, 93% of students felt that the computer-based lectures were more effective or much more effective than traditional techniques in helping them learn the material.
- The vast majority of students (87%) rated the technology positively on all three of these questions.

Long-established Canadian DE institutions that make optimal use of state-of-the-art course design, high-quality multimedia materials, and comprehensive, responsive support services—such as The Open Learning Agency (OLA) in British Columbia, Athabasca University, and Memorial University in Newfoundland—report that their graduates consistently score equal or higher marks than non-DE students at later entrance examinations as they advance their education.

Online students are “generally older, have completed more college credit hours and more degree programs, and have a higher all-college grade point average (GPA) than their traditional counterparts.”⁹ For example, Diaz (2002) has noted that online students received twice as many “A”s as traditional students, and half as many “D”s and “F”s.

According to a study by The Sloan Consortium—a network of institutions that study and promote online learning, 57% of 994 leaders in academia think online learning is at least as effective as courses offered in a traditional classroom setting.¹⁰ Brigham (2003), in a benchmark survey of 4-year institutions’ DE programs, found that 66% of the distance-learning institutions had an 80% or better completion rate for their DE courses, and 87% had 70% or better completion. Diaz (2002) asserted, and others concur, that “many online students who drop a class may do so because it is the ‘right thing’ to do.”¹¹ In other words, because of the conflicting demands on time and other limited resources of school, work, and/or family life in general, students can

⁹ See Diaz (2002), pp. 1–2.

¹⁰ *Daily Herald*. 2004. New Acceptance of On Line Learning Fuels Explosion. 21 March.

¹¹ See Bolam and Dodgson (2003) and Allred (2003).

benefit more from a class if they take it when they have enough time to apply themselves. The advantage they have is that they can “plug back” into the system at a time more suitable for them and pick up again where they left off, with relatively little fuss or procedural and bureaucratic impediments.

Today’s college and university students are unlike past generations. They are “interested in [qualifications from] small modules and short programs...and in learning that can be done at home and fitted around work, family, and social obligations.”¹² Information-age learners prefer “doing” to “knowing”, trial-and-error to logic, and typing to handwriting. Multitasking is a way of life for them, staying connected is essential, and there is zero tolerance for delays. Further, modern literacy includes not only text but also image and screen literacy—it involves navigating information and assembling knowledge from fragments.¹³

Contemporary adult learners tend to be practical problem solvers. Their life experiences make them autonomous, self-directed, and goal and relevancy-oriented—i.e. they need to know the rationale for what they are learning. They are motivated by a desire for professional advancement, to better serve others, to improve social relationships, to indulge in escapism or stimulation, and often to simply indulge an interest in a subject. This is a luxury previous generations rarely enjoyed. In any case, they must do this within constraints of time, work schedules, financial resources, and family and other long-term commitments.

Consequently, in many parts of the developed world, the combination of more and more learners, broader access, more sophisticated and demanding labor-market requirements, and a pervasive sense of entitlement, are forcing governments, policy makers, educators, and trainers to find more effective, inclusive, and cost-effective modes of delivering high-quality education. The greatest pressure in this regard is being felt at the secondary and higher levels.

¹² See Bates (2000), p. 5.

¹³ See Oblinger et al (2001), and Jones and Pritchard (2000).

B. Learning Materials

Traditionally, students have learned about the world from teachers in classrooms and labs and through books. Now technology allows them to obtain—at their own initiative—in-depth information about an unprecedented array of subjects and cultures electronically by, for example, corresponding with their global peers via their mobile phones (“texting”) and personal computers. Microsoft Encarta¹⁴ and the like have proven outstanding sources of easily accessible, understandable, and often fascinating reference materials that are browsed and absorbed eagerly. For many students, acquiring knowledge in this manner is more like fun than study.

Through Schoolnet Canada, and in some schools in the United States (US), the United Kingdom (UK), Singapore, and the Republic of Korea, students are using e-mail, web sites, streaming video, and video conferencing technology to develop their learning skills. Through these media, the students learn, compete, interact with their global peers, and share their cultures with one another in new and compelling ways.

C. Education Administration

Traditional faculty roles are, to borrow a word from the cable television and telephone carriers, “unbundling.” Increasingly, a single faculty member is no longer responsible for all technological and pedagogical functions relating to a course. Universities are disaggregating instructional responsibilities and allocating them among specialized professionals.¹⁵ This requires a “deliberate division of labor among the faculty, creating new kinds of instructional staff, or deploying non-tenure-track instructional staff (such as adjunct faculty, graduate teaching assistants, or undergraduate assistants) in new ways.”¹⁶ DE teams include administrators, instructional designers, technologists, and instructors/facilitators.¹⁷ The functions of instructors and facilitators then include being a “facilitator, teacher,

¹⁴ See <http://encarta.msm.com/>.

¹⁵ See Paulson (2002), p. 124.

¹⁶ See Paulson (2002), p. 126.

¹⁷ See Miller (2001) and Williams (2003).

Best Practice: Modularized Course Objects

British Columbia's Open Learning Agency (OLA) is one of the first post-secondary institutions in the developed world to implement a Learning Object Repository (LOR). It is the successful culmination of 5 years of research and development and a multimillion dollar investment. Although there are other learning object repositories, OLA is the only organization that uses its LOR to create, revise, and maintain courses.

OLA's LOR, is a database of "course objects" composed of various media used for course assignments, course information sheets, activities, lessons, assessments, course units, and the courses themselves. Course objects are created, tagged, catalogued, and stored in the repository. These are then assembled to create courses for web or print delivery. This enables OLA to use a "write once-publish many" approach—that is, to write course objects once and re-use them in different contexts.

The LOR is fully integrated with OLA's other systems. It allows OLA to combine learning objects from the database to create or revise courses and integrate them into industry-standard course management systems such as WebCT and its Banner Student Information System. Unlike the initial "cottage-industry" approach to post-secondary course development, where course designers are independently responsible for the development of a course from beginning to end, OLA has standardized course development processes by using consistent instructional design and production templates, centralized storage of learning objects, and strict version control, greatly enhancing productivity and course quality.

This standardized approach has reduced course development time from an average of 24 months to approximately 6 months (on average), from start to finish. OLA has been able to more than double new course development and production, and course revisions, with 20% fewer staff.

What are the future benefits? Use the standards on which OLA's LOR is built to facilitate collaborative course development among many institutions and consortia. The value of this learning object repository approach is that it has moved course development from a "cottage-industry" to a mass customization model.

Peter Donkers 2004^a

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organizer, grader, mentor, role model, counselor, coach, supervisor, problem solver, and liaison.”¹⁸

Many of the more dynamic and forward-looking tertiary institutions in the developed world are actively recruiting successful seasoned executives as faculty. Their “real world,” practical, no-nonsense approach, often spiced with anecdotes culled from personal experience, is proving highly appealing to all generations of learners.

The role of educators in DE however, requires specialized skills and strategies. DE teachers must plan ahead, be well organized, and able to communicate with learners in innovative ways. They must be accessible to students and able to work in teams when appropriate.¹⁹ They must be skilled in maintaining communication, as experience reveals the value of student-teacher interaction in DL.²⁰ Finally, they may have to assume more administrative responsibilities than is typically the case in a residential education model.²¹ The marshalling, monitoring, and stimulation of peer groups, whether online or on-site, becomes a specialized set of skills that is a key requirement for teachers in the DE environment.

A survey of teachers of basic writing courses across the US revealed a disparity in the use of technology in developmental programs. The successful application of educational technology depends on many factors; two of the most important are (i) having a sufficient number of learners participating (a “critical mass”) so as to make the application economically sustainable, and (ii) employing technology of a type and level appropriate to the particular educational objectives of both teachers and students. This does not mean that every student must have his/her own personal computer. Experts believe that in classroom situations, a minimum of one computer for every four to five students is required if students are to realize significant gains. In any case, educational technology is best accessible in classrooms or in areas where the learning is taking place, rather than housed in access-limited labs or resource centers.

¹⁸ See Riffée (2003), p. 1; Roberson, et al (2002); and Scagnoli (2001).

¹⁹ See Penn State University Strategic Plan (1998), p. 4.

²⁰ See National Education Association (1998).

²¹ See Penn State University Strategic Plan (1998).

D. Education Management Information Systems

Increasingly, administrative and institutional accountability for resources invested in education is driving the development of education management information systems (EMIS). Monitoring and evaluating programs and outputs using an EMIS provides information, which can be used to improve efficiency, optimize resource allocation, and reinforce performance. At the local level, learner and parent groups, as well as local school boards, require information about educational performance and outcomes in order to make decisions and promote those decisions vis-à-vis local government. In the often highly politicized context of planning and resource allocation, an effective EMIS can play a pivotal role.

In most developed countries, a ministry of education or an agency under the ministry's authority is responsible for the development and promulgation of a national or regional (jurisdictions vary) EMIS covering the entire education sector: schools, colleges, universities, TEVT, adult education and training, early childhood development, education for learners with special needs, further education and training institutions, as well as specific government programs dealing with, for example, teaching new job skills to unemployed workers in declining industrial sectors. Ideally, at this level, an EMIS should:

- Ensure that comprehensive and accurate data on all aspects of the system (student performance; staff efficiency; institutional, physical, and financial resource inputs; demographic trends; etc.) are systematically collected and processed so as to provide education planners with all the information required for optimum policy and program development.
- Provide technical assistance (TA) and advice to provincial, state, or district education departments and institutions, enabling them to monitor and evaluate their own performance.
- Continually seek to identify and develop more precise and accurate indicators for monitoring and evaluating all aspects of the education system.

- Coordinate research, development, and training activities on EMIS in collaboration with other partners in the education community.
- Secure funding support from national and international agencies for the expansion and development of the EMIS for institutions within its home jurisdiction.

E. Tutorials, Global Links, Skills Development, and Lifelong Training

Tutorials

In the all-too-often absence of adequate institution-based faculty development and support and training programs for DE, faculty members typically tend to use their conventional classroom methods to teach at a distance. They become frustrated when their attempts are unsuccessful.²² In Green's (2002, 7) survey of the role of computing and information technology in US higher education, most senior academic and information technology officials agreed that the single most important ICT issue confronting their campuses over the next 2 or 3 years was "helping faculty integrate technology into their instruction."

Today, a significant amount of audio-visual product not initially designed for formal education has proved to be excellent instructional material and is produced in a medium well-suited to ICT and DE. Examples include the various David Suzuki²³ television series, such as "The Nature of Things" (Canadian Broadcasting Company), and Discovery Channel and History Channel documentaries. A teacher using traditional textbooks and blackboard would hardly expect a class to become knowledgeable in tectonic plate physics in 60 minutes. Yet Dr. Suzuki, with his non-threatening approach and a compelling combination of exotic film locations, sense of adventure, and supplementary resources—such as video clips and interviews with

²² Dasher-Alston and Patton (1998), p.14.

²³ See <http://www.davidsuzuki.org/>.

world experts, not only leaves a class with a good basic grasp of the subject, but instills in some individuals a desire to learn much more about it. Similarly, 22 years ago, millions of young viewers learned the basics of satellite communications when “ET called home!”

The use of television programs (in both documentary and dramatic form) and electronics-based presentation technology, such as PowerPoint, slides, and projected video, has been a standard for many years in classrooms of the developed world. However, access to and selection of these media and the educational resources they open up has now been passed to the learner, through the personal computer and peripherals designed and priced for the home market. The teacher guides, motivates, and monitors, while the courses and course content are prepared with the media in mind by specialized designers of instructional courses and materials to communicate the content in a compelling way.

Several current computer programs, such as The 10 Minute Publisher,²⁴ which includes an entertaining interactive self-instruction course on a CD,²⁵ allow the creative teacher to translate an entire course to multimedia relatively easily. The course can then be shared (as well as reviewed and amended) over the Web with the teacher’s peers, and followed by hundreds of learners, including many who are not able to attend classes. Utilizing sophisticated software that works invisibly (i.e. “transparent”), the programs allow a teacher to accomplish complex operations more or less intuitively. Such programs offer a means of authoring, storing, retrieving, and presentation of text, images, sound, and movies that hugely facilitate publishing in a variety of media. The “user-friendly” characteristics of the technology, offering digital organization, integration, and presentation capabilities, encourages novice users—whether teachers or students—to incorporate it into the teaching/learning process with confidence and relative ease.

²⁴ See <http://www.leboe-grice.com/>.

²⁵ CD = compact disc.

Global Links

Many prestigious universities in the developed world are extending their global outreach through strategic relationships with other top-line institutions in the developing world at a fraction of the cost of opening a satellite campus. They bring their credibility, management expertise, course content, monitoring and evaluation systems, and technology to the new partnership. For example, California's renowned Stanford University announced that undergraduates will be able to live and study in Beijing during the 2004—2005 academic year through a new Overseas Studies program established in collaboration with Beijing University. During the program's first year, up to 30 students will be admitted in each of the fall and spring quarters. In the following academic year, a winter quarter program will be added. In addition to opening the Beijing campus, Stanford hopes to launch a program in India within the next 2 years in affiliation with an institution in New Delhi. In late 2005, it plans to offer a 10-week seminar in public health in affiliation with the University of Cape Town in South Africa.

The Canadian Institute of Business & Technology Corporation (CIBT),²⁶ a subsidiary of Capital Alliance Group Inc. and already a leading presence in business education in China, announced that it has signed an agreement with Western International University,²⁷ a subsidiary of Apollo Group, Inc., to deliver the university's bachelor and master degree programs to China. CIBT has received formal approval from the Beijing Education Commission to deliver these new programs at CIBT campuses in China. China's National Bureau of Statistics reported that over 320 million students are enrolled in 1.35 million schools across China, making it the largest education system in the world.²⁸

²⁶ See <http://www.cibt.edu>.

²⁷ See <http://www.wintu.edu>.

²⁸ Source: CIBT, October 1, 2003.

Earning through Learning

More than any other force, the market seems to be among the most compelling reasons for many providers of education getting on line. This is not surprising. Depending on whose statistics you accept, the total global expenditure on education could range from \$1 trillion (World Trade Organization [WTO] 2000) to other estimates of about \$2.1 trillion. The second figure seems to include money spent by corporations and others on training. If the WTO has its way, it is very likely that within a few years trade in education will be open to global competition and can be expected to surpass all other trade in the services sector. Many observers of the WTO expect this trade to be part of negotiations in the next round of talks. It is therefore not too difficult to see why predatory entrepreneurs and cash-strapped vice-chancellors find online delivery an attractive opportunity. In only international trade terms, the service is worth around \$27 billion, and the major suppliers of the trade are nations of the Group of Eight community, with the US, UK, Canada, and the Netherlands leading the pack. Generating around \$7 billion worth of service trade for the US, education exports rank fifth in their earning capacity.²⁹

The outstanding commercial potential of education and training through open and distant learning is rapidly gaining recognition. The e-learning market is experiencing rapid growth. In April 2001, according to a Merrill Lynch report quoted in Eduventures.com, total global e-learning was projected to grow from an estimated \$3.6 billion in 1999 to \$25.3 billion in 2003. In 2002, according to the same source, the European Commission announced the adoption of a \$13.3 billion e-Learning Action Plan, utilizing online learning within the European Community in order to remain competitive in the technological age. The Plan will be deployed over 3 years and spread over all levels of education.

Global telecommunications and Internet technology companies, education and training publishers and providers, service providers, national and supranational government agencies are all investing in this new industry. Household names such as America Online Time

²⁹ Condensed from "On-Line Learning – A Social Good or Another Social Divide?" Keynote Address by Professor Gajaraj Dhanarajan President and Chief Executive Officer, The Commonwealth of Learning International Conference on Learning and Teaching On-Line South China Normal University Guangzhou, China 10 January 2001.

Warner, Cable & Wireless, Nortel Networks, Microsoft, British Telecom, American Telephone and Telegraph (AT&T), and the European Commission are all increasing their stake in this market.³⁰

In Asia, there are a number of outstanding examples of private sector interests teaming up with firms in developed countries to enhance the semi-professional skills of qualified and motivated individuals. Infrastructure Leasing and Financial Services (India), Education Technology Services Limited (IL&FS ETS), a subsidiary of the huge Indian conglomerate,³¹ has two such ventures. The first, Schoolnet Academy of Insurance and Financial Advisors (SAIFA),³² in which expertise and best practices and standards were acquired from Canadian Association of Insurance and Financial Advisors (CAIFA), is training and licensing over 100,000 life insurance agents for the newly liberalized Indian market. The graduates are assured of quasi-professional recognition since both CAIFA and SAIFA will be providing accreditation. Such credibility will allow graduates greater employment flexibility and mobility, and a base to further advance their skills in a ladder process whereby they can eventually qualify for lucrative estate and investment management positions. In the second venture, IL&FS, through Adult and Vocational Learning, develops core competencies to improve the training or learning skills of individuals employed by government and institutions.

IL&FS ETS recently launched Job Plus, an activity-based program that incorporates many innovative and cutting-edge learning tools. The program addresses critical career and job-related needs of younger people who experience difficulty in choosing from the wide range of job options and career opportunities available today. It provides a platform for students to analyze themselves (their aptitudes, interests, strengths, and weaknesses), and assists them in making a choice that is right for them—instead of them being subject to the traditional preferences of parents, teachers, and peers. Job Plus

³⁰ Adapted from Judith Calder. 2002. *Skills Development through Distance Education*. COL. Chapter 2.

³¹ IL&FS is an institution with strategic focus on physical infrastructure (roads, ports, dams etc.), social infrastructure (education and health), and a comprehensive spectrum of financial service activities. The shareholders of IL&FS include Unit Trust of India, Central Bank of India, State Bank of India, Housing Development & Finance Corporation, and the International Finance Corporation, a member of the World Bank Group.

³² See <http://www.schoolnetindia.com/avl/saifa.asp>.

Table 1: Examples of Stakeholders in Technical Education and Vocational Training using Distance Education

Sector/ Geographical	Public	Non-Profit/ NGOs	Private / Corporate
International	World Bank UNESCO European Commission UNDP InterAmerican Development Bank	COL International Extension College Aga Khan Foundation	WorldSpace Foundation, AT&T/British Telecom, BBC World, Cable & Wireless, Microsoft, General Motors University of Phoenix Sun Life Insurance
National	Government departments	National Extension College (UK)	Schoolnet (India), IBM Starbucks, McDonald's
State/ Regional	State Open Universities (e.g., PRC, India) OLA (British Colombia, Canada)	State Resource Centres for Adult Education (India) Scottish University for Industry	Small enterprises providing training Employers
Local	Local schools and training centers Employment Commissions	USP Women's groups	Small enterprises Employers City of Vancouver
Individuals	Agricultural workers Unemployed Refugees	Local credit unions Volunteer members Arthritis Foundation CDC Atlanta	Employees CGA (Canada) CAIFA
<p>AT&T = American Telephone and Telegraph, BBC = British Broadcasting Corporation, CAIFA = Canadian Association of Insurance & Financial Advisors, CDC = Center for Disease Control, CGA = Canadian Government Association, COL = Commonwealth of Learning, IBM = International Business Machines Corporation, NGO = nongovernment organization, OLA = Open Learning Agency, PRC = People's Republic of China, UK = United Kingdom, UNDP = United Nations Development Programme, UNESCO = United Nations Educational, Scientific, and Cultural Organization, USP = University of the South Pacific. Source: Adapted from Judith Calder, COL.</p>			

helps the job seeker distil his or her options from hundreds of career possibilities, through effective use of information that is personally unique.

An increasing number of private sector enterprises include public interest education and training as part of a stakeholder alliance with a local community or a trade union. For example, the strategies of insertion of the Coca-Cola/Harry Potter literacy program are determined by Coca-Cola's local companies in order to reflect

variations in cultural tastes.³³ The same kind of specialized training tied to corporate advocacy is offered by Cisco, Hewlett-Packard, Nokia, Siemens, Nortel, Motorola University, and many others. The outcomes are often excellent for the trainees, and they provide certificate-level accreditation in high-demand information technology (IT) fields, which helps enhance trainees' overall access to degree programs.

Two key features, which are important in determining the nature of the interest of stakeholder groups, are (i) the sector to which they belong (public, non-profit/nongovernment, or private/corporate), and (ii) the geographical scope of their interest (local, state-wide, national, or international). The following table gives examples of the different types of stakeholders and their respective scope of interest.

E. Distance and Mixed Mode Education

At the Millennium, the US Association of Governing Boards of Universities and Colleges estimated that a third of all colleges and universities would be closing within 10 years.³⁴ Peter Drucker, the well-known management guru, recently predicted that higher education institutions as we know them today will be relics in a matter of a few short years. The message was: change or die. The force behind the change is digital technology and DE.³⁵

One of the first innovations in education was DE. Indeed, the concept and practice of DE is far from new. Correspondence courses have been in operation for a very long time—at least 100 years. Students in Malaya were able to take graduation courses from the University of London in the late 1940s. In those days, postal services played the vital communication role and constituted a very slow network. Students received lessons and assignments delivered by post. They then completed them, sent them by mail in return, and waited for their assignments to be marked and graded. The process was painfully slow and inconvenient, especially when the most economic mode was for these materials to be sent via surface or sea mail. It was

³³ See Education Guardian Weekly (2001).

³⁴ See <http://www.agb.org/>.

³⁵ Parker, Angie. 2003. Motivation and Incentives for Distance Faculty, Yavapai College Distributed Learning Online. *Journal of Distance Learning Administration* Volume VI, Number III, Fall.

not uncommon that a student would spend 5 to 10 years—or more!—to graduate.

Although it has taken a long time for DE to gain credibility, particularly at higher academic levels, the advent of ICT has radically changed the picture. Today, one can complete an online MBA within a year-and-a-half, or less, depending on the diligence of the student and the quality of the material and the support. The primary communication medium is now the Internet, which allows two-way real-time counseling sessions by voice and video, a capability that has never before existed. An entire class dispersed across the globe can share knowledge—often in real time—through an online chat room.

More and more learners are requiring flexibility in program structure to accommodate other responsibilities, such as jobs and families. Learners literally shop around for courses that best accommodate their schedules and learning styles, and then have the option of transferring their credits to a university where they can complete their degrees as time and finances permit. Students have unprecedented choice and flexibility. It is a growing trend.

As of 1999, 77% of all students graduating with a baccalaureate degree in the US and Canada had “attended” two or more institutions, a clear measure of student demand for an online option in their academic program. In a 1998 poll of the fifty US state governors, fully 83% identified “allowing students to obtain education anytime and anyplace via technology” as a critical characteristic of universities in the 21st century.³⁶ The same survey indicated that the top four items perceived to be most important were:

- Encouraging lifelong learning (97%).
- Requiring post-secondary institutions to collaborate with business and industry in curriculum and program development (77%).
- Integrating applied or on-the-job experience into academic programs (66%).

³⁶ See de Alva (2000), pp. 34, 38. De Alva is the President of the University of Phoenix.

Best Practice: Cyber U., a segue to mixed mode environments

Phoenix Rises

An especially enlightening article appeared in November 2003 in the magazine *Publishing Trends*, entitled "Phoenix Rising, Online Learning's 600-Pound Gorilla Tangos With Textbook Publishers." It was there recognized that not only are adult learners choosing to attend a highly credible distance university with no traditional buildings or central campus, but that a new kind of development is taking place in learning materials. This has the traditional educational institutions and publishers very worried.

The University of Phoenix, an Arizona-headquartered, for-profit institution offering degrees in adult-education basics such as business administration and information technology, may seem an odd candidate to be turning the world of higher educational publishing upside down. Yet as the United States' largest accredited university—163,627 current students (72,230 attending via the Internet), 17,200 instructors, 128 campuses in 26 states, and Internet delivery worldwide—there's good reason why publishing insiders are calling Phoenix the Wal-Mart of the higher education world.

Phoenix, widely recognized as the company that invented for-profit education, may today represent a very small proportion of the 16 million students enrolled in higher education programs in the US. But by leveraging infrastructure across its entire student base, and centralizing curriculum development, it has become the first vertically integrated higher education company, since it controls both content and distribution. When it adopts a textbook or other learning material, for instance, its curriculum design experts carefully select the content materials that are the most relevant for all sections of a particular course. Student feedback is solicited continually, especially about the university's online learning tools, which are fast becoming the centerpiece of its entire educational mission.^a

Massachusetts Institute of Technology

The prestigious Massachusetts Institute of Technology (MIT) offers another example of an organization undertaking cross-sectoral activities when it announced that its course materials would be made freely available on the Internet over the next 10 years. With the publication of 500 courses, MIT offers educational materials from 33 academic disciplines and all five of MIT's schools. In its "Welcome to MIT's OpenCourseWare" , the

(continued)

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(continued)**

institution states that this is a free and open educational resource for faculty, students, and self-learners around the world.

Cappella University

On 02 October 2003, Capella Education Company, the parent company of Capella University,^b was named to the Inc. 500 list of fastest growing private companies for the fifth year in a row. The company was ranked 179th in a field of 500. Capella University is an accredited US online university that offers more than 80 degree programs and specializations. The university serves more than 7,000 enrolled learners located in all 50 states and in more than 40 countries. Over the 4-year period ending in 2002, Capella's revenues increased by more than 922%, with 2002 revenue at \$49.5 million.

^a See: <http://www.uopxonline.com/>

^b See <http://www.capellauniversity.edu>

The four items judged to be of least importance were:

- Maintaining faculty authority for curriculum content, quality, and degree requirements (44%).
- Preserving the present balance of faculty research, teaching load, and community service (32%).
- Ensuring a campus-based experience for the majority of students (21%).
- Maintaining traditional faculty roles and tenure (3%).³⁷

In this demand-response model, education becomes a commodity, and the student a consumer, shopping for the best deal.³⁸

³⁷ See de Alva (2000), p. 32.

³⁸ See Johnstone et al. (2002), Pond (2003), West (1999), and Dubois (1996).

G. The Current Status of Distance Learning

Prognosticators seem to be having a field day estimating the current and potential size of online learning, and their figures vary wildly. In the US, Booz, Allen, Hamilton forecast this market would be worth \$12 to 14 billion in 2004.³⁹ International Data Corporation (IDC) claims the corporate e-learning market, which was roughly \$5.2 billion in 2001, is expected to exceed \$23 billion by 2006, a worldwide increase of more than 35%.⁴⁰ By 2005, revenues in the US for virtual-classroom software and services are expected to exceed \$1 billion, according to Lewis Ward, senior research analyst for San Francisco-based Collaborative Strategies.

Organizations at every level of education are adapting to accommodate the growth in the demand for DL. As human resource professionals and personnel managers become more accepting of online degrees, more and more traditional university systems are spinning off online universities. In addition to those already mentioned, there are Penn State's World Campus,⁴¹ Arizona Regents University,⁴² California Virtual Campus,⁴³ and many others. The distinction between distance and on-campus education is blurring as universities digitally enhance more and more courses. Digitally-enhanced courses provide students in traditional classrooms with more opportunities for independent study.

The market in Asia is still minimal compared to the west. However, western educators view Asia as having huge, untapped potential. Indeed, the markets in China and India are seen by content providers as future bonanzas. In these markets, just as it is in the DL market in general, the greatest potential lies in the professional and corporate market segments. Content developers therefore are likely to invest heavily in this sector, leaving the formal educational sector as second tier. Fortunately, there are still dedicated content developers who will continue to meet the needs of the traditional education market.

³⁹ See French, Marlene. *Re-learning E-Learning*. Booz Allen Hamilton.

⁴⁰ See Kaplan, Ari. 2004. *The Worldwide classroom*. Available: <http://www.computeruser.com>.

⁴¹ See <http://www.worldcampus.psu.edu/pub/index.shtml>.

⁴² See <http://www.arizonaregentsuniversity.org/>.

⁴³ See <http://www.cvc.edu/>.

As more and more knowledge becomes available online, a great deal of printed material is obsolescent, if not obsolete. This is especially disquieting for post-secondary institutions in developing countries, which are attempting to ensure that their students achieve equivalent outcomes and are able to compete with graduates in the developed world. This is particularly true in rapidly evolving disciplines such as pharmacy, medicine, optometry, library sciences, engineering, agriculture, computer technology, nursing, etc. Visits by the author to a number of post-secondary institutions in Asia and the Pacific during 2001—2002 revealed freshly printed copies of DOS⁴⁴ manuals being readied for distribution to computer science students. There were no plans to modernize the material since teachers were comfortable with it, and there were few if any opportunities for them to update their own knowledge. A brief review of printed learning materials in many other sectors demonstrated that the problem was not unique to technology courses, but was widespread across departments and faculties.

As stated earlier, the private sector will concentrate on those areas that promise the most profit, such as business programs and information technology. However, it may ignore those areas with lower or negative financial returns, such as arts and social science programs and health sciences for the public sector, unless they can be assured of sufficient volume to justify the costs and risks of program development, marketing, and support services. Currently, only 4% to 5% of all higher-education students are enrolled with for-profit providers, but 33% of all online students are enrolled with such providers.⁴⁵

The proliferation of communications technology throughout the developed world is undoubtedly increasing the options for distributing education to more people in a scalable fashion, but this expansion will always be constrained by the prevailing levels of technological fluency or literacy. The two factors—technological capability and ICT literacy—form a positive feedback loop; as technology spreads technological literacy must of necessity rise, and vice versa. They simultaneously nourish and constrain each other. This interdependence and the need for a balance between the two must

⁴⁴ Disk operating system (DOS) has been obsolete for at least 10 years.

⁴⁵ See Gallagher (2003).

be recognized. The Internet and the personal computer arguably play the most powerful role in this process.

The networked world is dominating the global economy, increasing the power of the individual, and changing business models; no one can afford to be without computer competence.⁴⁶ Universities are beginning to consider technological fluency a specific outcome skill and are encouraging students to take online courses, in some cases requiring students to take at least one online course before they graduate.

The evidence points overwhelmingly to the conclusion that teaching and studying at a distance, especially when using interactive telecommunications media combined with periodic classroom sessions, is effective when measured by such indices as the achievement of learning, the attitudes of students and teachers, and return on investment.⁴⁷

In 1995, fewer than 50 Virginia Tech students registered for online classes at the Blacksburg, Virginia school. In 2001/02, over 10,000 Virginia Tech students—many of them full time and living on campus—chose to take classes through their personal computers. As with adult learners, the DE option provides traditional students.

CNN.COM/Education 22 July, 2003

⁴⁶ See Oblinger (2000).

⁴⁷ See Global Distance EducationNet (2000).

H. Assessment and Monitoring

Indicators of student achievement are key to evaluating technology-mediated learning. Although standardized test scores are valid and widely used barometers for determining achievement, they are not the only tools available for assessing the efficacy of technology in student learning. Technology-oriented performance indicators can be set up to capture and report a variety of descriptive assessment data using student portfolios and assessment rubrics.⁴⁸

There has been rapid development and integration of ICT into daily life. Parents, teachers, and the business sector have increased their expectations that schools ensure students are “ICT literate.” ICT has the potential to improve the education system by:

- Assisting students’ ICT skill development,
- Increasing students’ interest, knowledge, motivation, and learning skills,
- Supplementing teachers’ instructional practices in the classroom,
- Expanding educational programs,
- Extending the learning environment beyond classroom walls, and
- Providing efficient administration and cost savings.

Less attention and funding have been committed to evaluating ICT contributions to teaching, learning, and teacher training. While it is generally agreed the use of technology in the classroom is beneficial for teachers and students, research that uses traditional measures of student achievement is inconclusive.

The British Columbia Ministry of Education has undertaken two comprehensive education technology reviews: (i) *Conditions for Success*, examining a wide range of issues related to use of technology in education, and (ii) *Evaluation of Electronically Delivered Education Program*, focusing on the Ministry’s policy and programs for the

⁴⁸ See Jones, Valdez, Nowakowski, and Rasmussen (1995).

delivery of kindergarten to grade 12 (K-12) education online. Both reports recommended that the Ministry prepare a long-term plan to manage the integration of ICT across the K-12 system and recognize the implications of ICT for the education system over the long term.

The ensuing plan reflects several underlying principles for the integration of ICT into the education system, consistent with basic values of public education. These principles include:

- Student needs and learning should be the focus of ICT; i.e. technology is a learning tool to assist learning.
- Through the use of ICT students develop skills that assist learning in other subject areas.(e.g. problem solving, communication, critical thinking, and collaboration).
- ICT should be integrated to ensure student participation, should accommodate different learning styles, and should support both individual and group learning processes.
- The application of technology, including the development of related ICT skills and their use as teaching and learning tools, must be supported by new teaching practices.
- Equity issues must be considered as part of ICT integration (e.g. gender, cultural, geographic, socio-economic).
- The integration of ICT must be a province-wide priority.
- Education stakeholders must have the opportunity to participate in decisions related to the use and integration of ICT.

Educational research should assess the impact ICT integration has on the education system, including student performance and attitudes, teaching and learning processes, and efficient administration. Priorities for educational research include:

- **Basic data collection.** Ensure assessment of ICT skills is part of the department's assessment program. Implement a data collection program on ICT in schools, including: students' and teachers' ICT skills, use of ICT across the curriculum, resource inventory, and ICT budgets and expenditures.

- **Program evaluation.** Develop assessment standards and methods to evaluate student and system performance. Develop and incorporate standards for successful integration of ICT into a school accreditation process.
- **Longitudinal research.** Develop and implement a research and evaluation program on the impact of ICT on student performance, teaching practices, and/or administration, including students' acquisition of ICT skills, knowledge and attitudes; improvement of other subject-specific skills (reading, writing, arithmetic), and higher order skills (critical thinking, problem solving, and communicating); students' attitudes toward learning and staying in school; development of teacher ICT skills, both through pre-service and in-service; effectiveness and efficiency of teaching practices using ICT; transitions to post-secondary education programs and employment; administrative/operational costs: analysis of the benefits of purchasing and using telecommunications, computers, software, electronic learning resources; and effectiveness, efficiency, and/or cost-effectiveness of ICT.

Today's cutting-edge teaching practices demand more. Methodologies employing the emerging technologies require current assessment tools that are not stand-alone occurrences. Educators need to evaluate and reward students for in-depth achievements based on perspectives reflecting the employment of the multiple intelligences, collaborative learning interactions, cognitive processes, and demonstrated competence. Educators must employ assessment approaches that evaluate the ongoing nature of the engagement of intelligence, individualized process development, curricular goals, and planned product.

True learning assessment is a natural, organic process, and Howard Gardner states that "As assessment gradually becomes part of the landscape, it no longer needs to be set off from the rest of classroom activity. As in a good apprenticeship, the teachers and the students are always assessing."⁴⁹ Therefore, the best assessment tools will be natural outgrowths of the creative process and its necessary

⁴⁹ See Gardner (1992).

Very few reading and writing research studies have investigated the changing nature of literacy with respect to information and communication technologies. I am concerned about generalizing findings from traditional texts or older technologies to new technologies. Each technology contains different contexts and resources for constructing meanings and likely requires somewhat different strategies for doing so. Research which begins within classroom context will assist us in better understanding how individuals interact with these new technologies and hopefully provide us with more comprehensive insights into how these technologies can best be used in our classrooms.

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stages of revision. Within an active environment of working toward a continual honing of skills integrated into an engaged, multiple intelligences process of product development and conscious goals, continual assessment occurs naturally.

Case Study: Making the Most out of Assessments⁵⁰

Unlocking the secrets of how children think when they are asked to solve a problem has long seemed as unrealistic as predicting the future in a crystal ball. Students often can't recall or explain in words how they reach an answer. And even when they turn in scratch paper or "show all work," paper-and-pencil tests usually can't reveal what information students used at which moment.

But what if a teacher could do the assessment on a computer? And what if a powerful database could provide not only a "map" of how each student solved a problem, but compile one class's performance and compare it to the performance of another group of students? It may sound like soothsaying, but it's for real! Welcome to

⁵⁰ 1998 Editorial Projects in Education.

the world of interactive multimedia exercises (IMMEX). Originally designed a decade ago at the University of California at Los Angeles medical school to test students' understanding of immunology, these computerized problem-solving assessments are now used regularly in more than a dozen elementary, middle, and high schools in southern California. Additionally, they are used for a variety of subjects, including math, science, English, and social studies.

"It's the closest I think [teachers] can get to getting inside their students' minds," says Kristin Hershbell, a research associate at the WestEd regional research laboratory in Menlo Park, California, which has been evaluating the IMMEX project. Paula Dallas, a biology teacher at Palisades Charter High School in the Pacific Palisades section of the Los Angeles, experienced that feeling recently with two classes of 10th graders who ran a Windows-based IMMEX problem set called True Roots. In this exercise, students play the part of forensic scientists asked to identify the true parents of a girl named Leucine—just like the amino acid—who suspects she may have been the victim of a mix-up in the maternity ward.

The idea is for students to solve the problem as efficiently as possible, selecting only the information that will be most useful to them. For example, they can access data from an "experts" category that includes the police, school officials, and hospital staff. By clicking on "lab tests," they can find blood types and the results of DNA (deoxyribonucleic acid) fingerprinting. The computer tracks what choices the students make, recording each step of their thinking for later review by them and the teacher. "You can look deeper," Dallas says of IMMEX. "You can see the process of how they go to the answer." Dallas is very familiar with this particular program, having helped write True Roots three summers ago when she attended the first annual teacher-training institute for the IMMEX project. The institutes, funded through a 4-year, \$2 million teacher-enhancement grant from the National Science Foundation, have trained more than 270 K-12 teachers in 65 southern California schools.

Dallas gives her students two class periods over 3 days to run the True Roots program, assigning two students to each computer. She uses the middle day to discuss how they did on their first try and what strategies they might use on their second try. They'll receive a grade—worth about 50% of the test—on how much they improve.

Just before Dallas convenes the class period between the two IMMEX runs, Ron Stevens, the inventor of IMMEX and a professor at

the University of California at Los Angeles medical school, sits in her classroom and shows her the students' "search-path maps" from the day before. For the first time, she sees a visual reconstruction of the thought processes her students used to solve the problem. She knows not only if they solved the problem, but how.

On each search-path map, lines zig and zag across the screen, showing the routes the students took in and out of the categories. She can tell if they entered, say, the blood-typing category, then jumped to another category, or dipped repeatedly into the DNA fingerprinting area. A tangle of lines means the students hopped from category to category without a good sense of how to solve the problem. A single line from starting point to answer means they guessed—a forbidden strategy that some students try anyway. By interpreting the patterns, Dallas sees which students were thinking analytically and which were not. She can also tell who learned their recent unit on genetics. And finally, using a scale developed by Stevens, she can assign a number value to the students' patterns, allowing her to compare the high schoolers' performance to that of their peers, as well as to that of undergraduates who have run the same exercise.

Programs such as IMMEX are not the only ways that educators believe technology can improve student assessments. Some teachers, for example, are using software to help with the often-unwieldy task of managing portfolios of student work. Electronic portfolios can make it easier to organize and retrieve documents than paper versions, but they also pose some technical problems and can be harder to share with others without a computer.

Other uses of technology are designed to streamline the assessment process. Researchers at the University of Colorado at Boulder, US, for instance, have designed software that they say can grade essays for content as well as teachers can. In the area of computer-based assessments, some educators are using tests tailored to individual students through computerized adaptive testing. The computer creates a unique test for each student who sits at the machine, selecting items that are appropriate for his or her ability, based on the student's responses to preceding questions. While all of these uses of technology in assessment seem promising, many educators are particularly intrigued by exercises like IMMEX because of the insight they offer into student learning styles. "Eighty percent of solving a problem is thinking about it in the right way," says Robert J. Mislevy, a distinguished research scientist at the Educational Testing

Service in Princeton, New Jersey, who has teamed up with the IMMEX project staff on a National Science Foundation grant proposal.

Assessment programs like IMMEX also raise the all-important question of whether students learn more, or differently, when they use computers. Some educational researchers believe that traditional forms of assessment can't adequately measure student achievement on performance tasks like multimedia presentations. Research on computer-based assessments—very little of which has been conducted so far—could begin to address whether they more accurately reflect students' abilities. The students say it's faster and easier to run a problem on the computer instead of having to shuffle through papers for a traditional exercise, and they seem to appreciate the intellectual challenge of IMMEX. As Tennille Hyde, age 15, said, "It puts your brain to work."

Research Reports and Studies

Each year, US legislators, governors, and other policymakers make difficult choices among attractive educational improvement options. Whether to invest in class-size reduction, teacher training, early childhood education, textbooks, or tests, depends on their estimates of the effectiveness of these approaches. What does current research have to say about the impact of education technology on student achievement?

a. Kulik's Meta-Analysis Study

James Kulik (1994) used a meta-analysis methodology to aggregate the findings from more than 500 individual research studies of computer-based instruction. Kulik drew several conclusions from his 1994 work.

Positive Findings. On average, students who used computer-based instruction scored at the 64th percentile on tests of achievement, compared to students in the control conditions without computers who scored at the 50th percentile. Students learn more in less time when they receive computer-based instruction. Students like their classes more and develop more positive attitudes when their classes include computer-based instruction.

Negative Findings. Computers did not have positive effects in every area in which they were studied.

b. Sivin-Kachala's Review of the Research

Jay Sivin-Kachala (1998) reviewed 219 research studies from 1990 to 1997 to assess the effect of technology on learning and achievement across all learning domains and all ages of learning. From his analysis of these individual studies he reported the following consistent patterns.

Positive Findings. Students in technology-rich environments experienced positive effects on achievement in all major subject areas. Students in technology-rich environments showed increased achievement in preschool through higher education for both regular and special needs children. Students' attitudes toward learning and their own self-concept improved consistently when computers were used for instruction.

Inconclusive Findings. The level of effectiveness of education technology is influenced by the specific student population, the software design, the educator's role, and the level of access to the technology.

c. The Apple Classrooms of Tomorrow

In their evaluation of the Apple Classrooms of Tomorrow (ACOT), Baker, Gearhart, and Herman (1994) assessed the impact of interactive technologies on teaching and learning in five school sites across the United States (e.g. California, Tennessee, Minnesota, and Ohio). The goals of ACOT were to encourage instructional innovation, and to emphasize to teachers the potential of computers to support student initiative, long-term projects, access to multiple resources, and cooperative learning. Over the course of the 5-year initiative, comparisons were made of (i) ACOT students' basic skills performance to nationally reported norms, (ii) ACOT students' progress and achievement over time, and (iii) ACOT teachers' teaching practices.

Positive Findings. The ACOT experience appeared to result in new learning experiences requiring higher-level reasoning and problem solving, although the authors claim this finding was not conclusive. ACOT did have a positive impact on student attitudes, and

did have an impact on changing the teaching practices of teachers toward more cooperative group work and less teacher lecturing.

Inconclusive Findings. On standardized tests, including vocabulary, reading comprehension, mathematical concepts, and work-study, ACOT students performed no better than comparison groups on nationally-reported norms who did not have access to computers or to the teaching and learning reforms implemented in ACOT schools.

d. West Virginia Basic Skills/Computer Education State-wide Initiative

Dale Mann's (1999) study of the state of West Virginia Basic Skills/Computer Education program analyzed a representative sample of the achievement of 950 fifth-grade students from 18 elementary schools across the state. These students had been participating in the West Virginia program since 1991—1992. Data was also collected from 290 teachers to show the influence West Virginia's learning systems technology had on student achievement. The learning systems technology focused its teaching on spelling, vocabulary, reading, and mathematics. Several variables were collected and analyzed, i.e. intensity of Basic Skills/Computer Education, student prior achievement and socio-demography, teacher training, and teacher and student attitudes toward Basic Skills/Computer Education.

Positive Findings. The more students participated in Basic Skills/Computer Education, the more their test scores rose on the Stanford 9. Consistent student access to technology, positive attitudes towards technology (by both teachers and students), and teacher training in technology led to the greatest student achievement gains. Half of the teachers in the sample thought that technology had helped a lot with the state's instructional goals and objectives. The teachers also reported that they became more enthusiastic about Basic Skills/Computer Education as time passed. Although the relative disadvantage of girls is a regularity of the technology literature, girls and boys did not differ in achievement, access, or use of computers.

Cost benefit analysis of the West Virginia Basic Skills/Computer Education program compared the cost of that program and its achievement gains to the cost of other reform programs and their achievement gains. The analysis demonstrated that Basic Skills/

Computer Education was more effective in improving student achievement than (i) class-size reduction from 35 to 20 students, (ii) increasing instructional time, and (iii) cross-age tutoring programs.

e. Scardamalia & Berieter's Computer Supported Intentional Learning Environment (CSILE) Studies

Recent advances in networked technologies are making working on a computer a social and collaborative enterprise. Marlene Scardamalia and Carl Berieter's 1996 CSILE studies, the most widely studied collaborative computer application on schools at the time, had entire classrooms of children conceive, respond to, and reframe what was said and written over time on computers. CSILE students asked questions, searched for other students' answers to their questions, commented on and reviewed other students' work, and then restructured and formulated answers to their original inquiries. Eight years of research on CSILE demonstrated that (i) CSILE students surpassed students in control classrooms on measures of depth of understanding and reflection, and also on standardized reading, language, and vocabulary tests; and (ii) CSILE maximized student reflection and encouraged progressive thought, multiple perspectives, and independent thinking.

f. The Learning and Epistemology Group at MIT

Seymour Papert,⁵¹ Michael Resnick, Yasmin Kafai, and Idit Harel⁵² have employed learning by design principles to education technology by having students become creators and designers of educational software. These researchers use the computer as the machine to be acted upon and students as the actors. Children thus learn through design activities by programming computers to create applications that other children use and learn from.

Research by Idit Harel introduced Logo programming to design software to teach fractions to younger students. Students had to structure their computer program, maintain connections between content and functionality, and design the user interface and activities.

⁵¹ See I. Harel and S. Papert (1991).

⁵² See I. Harel (1990).

In addition, students needed to consider different ideas about how to teach fractions to younger students. Harel's research demonstrated that (i) students who designed fraction software for other students using Logo learned fractions better than students taught fractions using conventional methods, and (ii) students who use Logo to design software learned Logo better than students who received Logo programming instruction only.

g. The National Educational Technology Standards

The National Educational Technology Standards (NETS)⁵³ Project is an ongoing initiative of the International Society for Technology in Education (ISTE) and a consortium of partners and co-sponsors. The primary goal of the ISTE NETS Project is to enable stakeholders in pre-kindergarten education to develop national standards for educational uses of technology that facilitate school improvement in the US. The NETS Project will work to define standards for students, integrating curriculum technology, technology support, and standards for assessment of students and technology use.

Instructional uses of computers began to creep into pre-college education the US in the late 1950s, and expanded in a long, slow, but continuing process. By 2003, we know that:

- K-12 schools had approximately one microcomputer per five students. While many of these were in computer labs, since 1999 more than half are in individual classrooms.
- Essentially all pre-college schools in the US have Internet connectivity, and most classrooms have Internet connectivity.
- It is increasingly common to find a pod of three to five Internet-connected microcomputers in a classroom.
- More than three-fourths of pre-college students have access to a microcomputer and the Internet at home.
- For many years, the US Federal Government has been making a strong push for increased connectivity and improving the effective use of computers in pre-college education.

⁵³ See <http://cnets.iste.org/>.

- In 1999, the number of employer-provided microcomputers per white-collar employee in the US averaged 1.05 per employee.

Educational systems are slow to change. The US educational system has proven ill equipped to accommodate the rapid pace of ICT change. Among the most difficult challenges has been the very rapid pace of change of ICT hardware. Computers began to be mass-produced in the early 1950s, and began to be widely used in business and industry during the 1960s. Over the past 35 years, the cost effectiveness (the amount of computer capability per dollar) has increased by a factor of more than a million.

During the past 35 years the ICT field has changed from having relatively little connectivity to having the Internet, the Web, and Internet 2—which is about a thousand times faster than the widely-used Internet. During this time, a huge software industry has developed. Some components of this industry focus specifically on educational software. Other components focus on entertainment, edutainment (a combination of education and entertainment), on general-purpose tools useful to almost all computer users, and on special purpose tools that are specific to particular disciplines and application areas.

Relatively widespread acceptance has gradually emerged of the view that students and teachers should be provided with adequate and appropriate ICT facilities. There should be ICT in education standards for students, teachers, and school administrators. Students should receive adequate and appropriate education in the use of ICT facilities. Curriculum content, instructional processes, and student assessment should reflect appropriate use of ICT that is thoroughly integrated throughout the curriculum. Teachers and school administrators should receive pre-service and in-service education to adequately prepare them to integrate ICT into curriculum content, instructional processes, assessment, and their other professional work.

I. Tutors and Support

The term “tutor” is used in its broadest sense to include, among others, academics, faculty, instructors, corporate trainers, animators, facilitators, moderators, subject specialists, and learning support staff. The technology tutor includes any person undertaking a role to support and enable students to learn effectively when using technology as a tool for learning.

Earlier case studies focus on the roles of the tutor in supporting collaboration based on constructivist principles through text-mediated asynchronous discussions. A few case studies describe synchronous work using videoconferencing and collaborative work through shared applications and workspaces, e.g. whiteboards. The majority of experiences reflect a more general trend in higher education toward student-centered learning. A minority of case studies reported a move toward separating the provision of content from that of learning support.

From this wide range of exemplars it is apparent that there is no single “correct” way to tutor in technology-rich environments. The definition of the tutor’s roles and activities must be understood within the specific context—i.e. the teaching/learning settings, the constraints of the environment, and the status of the learners, the tutor, and the pedagogical model. In order to provide a framework for tutors to understand their roles in different contexts, there are examples of online learning and teaching from a range of different scenarios.

There are numerous similarities between tutoring in a technology-rich environment and face-to-face pedagogy—e.g. encouraging, probing, eliciting, and enabling reflection. In the online environment tutors are the interface between the institution and the student. Tutors need to understand both the environment in which they are working and the teaching techniques that are effective in this environment: Good teaching requires a sound understanding of the specific environment, whether traditional face-to-face, technology-rich and mediated, or a newly-created online environment.

At present, online learning environments are predominantly text based. A tutor may be involved in activities such as support, discussion, collaboration, and moderation using text-based communication. These interactions may be synchronous or

asynchronous, and the use of multimedia, audio, video, graphics, shared applications, and shared workspaces may be necessary.

The tutoring techniques used in a technology-mediated or online environment differ considerably from those used in face-to-face situations, and preparation of activities may rely more heavily on teamwork with instructional designers, multimedia specialists, and other technical experts working alongside the subject expert. The design of learning activities should consider the distinguishing features of the online learning environment:

- The absence of cultural markers (e.g. physical appearance, speech and voice, ethnicity, race);
- The different nature of interaction between student and tutor;
- The use of a different kind of text—at present, online communication is primarily text and image based, and text is presented as spoken text in written “form;” and
- The need to encourage reflection and deep learning—it is questioned whether the use of technology facilitates “surface learning.”

In technology-rich and online learning environments, the tutor must manage a course, guide students throughout the learning experience, motivate them, interact with them, assess them, and deal with any conflicts or difficulties. The differences in tutor role result from the characteristics identified above: the absence of non-verbal clues, the use of text as the main means of communications, and the constraints imposed by technology.

It is clear that tutoring in technology and online environments is different from face-to-face teaching, and research demonstrates that there is no single “correct” way to tutor.

Challenges Facing Students

Muirhead (1999) outlines the problems and challenges that students may face:

- Students may feel isolated from other learners and tutors.
- Students may face communication problems with other students or tutors (e.g., inadequate feedback).
- Students who are constantly late in posting their comments and students who fail to do their group work can have a negative impact on the quality of interaction.
- Students may struggle with writing online comments and work for assessment.

Responsibilities of Students

Students need to be encouraged to take responsibility for their own learning, because they have an important role to play to facilitate effective learning. They should be able to construct their own learning. They will have their own issues and agenda, yet the problems they face are often “global.” They need to manage their own time. It is useful if they are proactive and willing to take risks, and they need to “trust.”

Tutors as Learners

Much of the research endorses the view that online tutors need to experience online learning as a student before they can effectively support other online learners. Priest (2000), an online learner herself, provides an interesting account of online learning experience from the student’s perspective. Priest suggests that an effective online program will help the student to succeed. She identifies the key elements that should be provided for a successful program:

- **Support services.** Information on how the institution functions and how it relates to individuals, together with assistance with administration and enrollment matters.
- **A social context for learning.** Membership of a learning community to allow the development of relationships with other students and provide support and feedback. Group work can help with this.

- **Effective communication and teaching practices.** Sensitive instruction and support—i.e., tutors who can ask the right questions, probe for information, and provide clear and detailed instructions. Tutors also need to be accessible by means that do not involve a computer.
- **Clear guidance through the curriculum.** Clear instructions and details of requirements for assessment.
- **Tolerance for differences.** Tutors who can guide and moderate discussions.
- **Motivation.** Tutors who can keep the learning process on track and sensitively handle problems with progress and performance.
- **Tracking attendance.** Students need to know that tutors can monitor attendance.

From the student's perspective, a tutor should facilitate and nurture a learning community, facilitate communication (including e-mail and offline methods), monitor attendance and contributions, support process-related activities, including learning skills, provide access to administrative and other support, provide sensitive online instruction (including group work) and moderation, guide students through their curriculum, motivate, tolerate differences, and help learners to achieve their objectives.

The Institute of Educational Technology at the UK Open University has produced a set of guidelines to help establish quality online tutoring in their courses. Their recommendations focus on interactions with students. They consider that tutors should be supportive in tone, demonstrate adequate knowledge of the course, provide a guiding presence in the conferences, answer direct requests for information, follow the discussions, provide summaries and feedback on the activities, weave in comments at appropriate points, and monitor the participation of all students in their allocated group.

By contrast, the Institute of Information Technology Training has compiled a comprehensive list of tutor activities based on a *Competency Framework—Online Tutors*.⁵⁴ Generally only a subset of these is required in each particular instance, according to the design

⁵⁴ See <http://www.iitt.org.uk/c-onltutor.htm>.

and application of a particular learning program. To help avoid the traditional roles of the classroom teacher, the tutor must adopt the new roles, and do this with flexibility and in responsiveness to learner needs.

Working in Teams

Several case studies provide evidence that team work is essential for effective subject or content tutors, and for learning support or process tutors.

The strategies and techniques used in tutoring vary according to the context for the learning experience, the pedagogy adopted, and the needs of students. However, there are some issues and experiences that cut across most learning situations.

- **Technology issues.** Tutors and students need to have the necessary technology-related skills in order for learning to be successful.
- **Tools, techniques, and structures for online learning.** When the technology operates effectively, attention can turn to the tools and techniques that are available for structuring and supporting communicating and learning.
- **Participation issues.** Active learning that takes place early in a course has a particularly important impact on the development of a supportive and motivating learning community.
- **Creation of autonomous learners.** After initial activities to get students involved and beginning to take responsibility for their learning, the opportunities for collaborative learning can be exploited.

Instruments to Support Tutoring

Few people learning to drive would want to begin on a racetrack with a Maserati. Yet many tutors get their hands on some relatively sophisticated application software and try to design and run an “online” course. When their experiment fails, they rarely blame themselves. Instead, they conclude that the medium is not much use for

learning. They will tend to reinforce other negative views about the use of ICT and impede attempts by their peers to modernize local systems.

For example, a teacher who is given only a short introductory course in Macromedia Flash—which has a very steep learning curve—will be far from competent enough to transform a course into a multimedia format, and may abandon the idea of using ICT for educational purposes. The Macromedia Flash program is rich and powerful, but far from intuitive. On the other hand, starting with a simple program, such as the Ten Minute Publisher, gives the teacher, writer, or administrator a solid level of confidence, and after a few successful results, the motivation and ability to move to a more powerful package.

Research over the last several decades indicates that technology used to improve student learning should embody instructional strategies that effectively engage students in discussion, debate, analysis, interpretation, and judgment. Teachers must be able to communicate with and motivate their students using technology equally available to teacher and learner. They must provide feedback and comment within a reasonable time. The ICT component of a course must be well integrated and consistently applied. Temporary, sporadic, or ad hoc use of ICT will result in declining student motivation and interest.

Once a multilateral, participatory mode has been established, students will expect their tutors to continue to encourage and stimulate discussion and exchange. Student motivation and interest is vastly enhanced if they feel their tutor has a personal interest in their progress and values the student's individual efforts, capacities, and contributions to the group. Online tutors should:

- Regulate the information flow so that course participants have sufficient challenge to stay motivated but do not feel overwhelmed by information and deadlines. Information must be carefully streamed, organized, and paced in order to avoid information overload and/or the frustration and defeatism created by data presented in an inchoate or poorly organized manner. The load and complexity of information will vary depending on the participants involved.
- Share information and feedback mechanisms, such as listserv, or online discussion groups should be organized by topic, theme, or subject area.

- Understand the need for a personal touch in maintaining a sense of cohesion among small groups. Tutors should work to create a friendly, social environment, acknowledging previous and ongoing contributions, either from students or other tutors, teachers, writers, subject specialists, practitioners, and experts. They should provide supportive feedback and foster various discussions by posing suitable questions.

Assessment Tools

The most commonly used assessment tools are:

- Assessment rubrics specifically designed for specific projects, lessons, and/or class experiences;
- Standard assessment tools (e.g. Wright Group Reading Assessments);
- Individual teacher assessment notes;
- Children's own metacognitive voices in the process of learning, in conference with the teacher, and in self-reflection of work and presentations; and
- Parents' reports of student learning progress.

For detailed and formal assessment and evaluation, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) has prepared Performance Indicators for ICT in education. It is but one of many valid lists of performance indicators that can be found on UNESCO's Web site. It has been selected in recognition of UNESCO's extensive and objective work in global education over many years.

An excellent review of educational software currently available and in widespread use in education has been sponsored by The Milken Family Foundation.⁵⁵ Entitled *Reading Programs That Work; a Review of Programs for Pre-kindergarten to Fourth Grade*, the comprehensive study was conducted by Dr. John Schacter and covers 27 popular

⁵⁵ The Milken Family Foundation was established by brothers Lowell and Michael Milken in 1982 with the mission to discover and advance inventive and effective ways of helping people help themselves and those around them lead productive and satisfying lives. See <http://www.mff.org/>.

software packages in widespread use in schools. His analysis concludes that effective comprehensive reading programs:

- Are based on empirical research, not ideology;
- Emphasize direct, systematic, intensive, and sustained reading instruction;
- Require school-wide acceptance by faculty and administrators before they are adopted;
- Are supported by initial intensive professional development and subsequent sustained training by the developer throughout the school year;
- Require commitment by the school to the integrity of the program's instructional approach and materials when implementing the program; and
- Make effective use of instructional time, provide multiple reading opportunities, and employ a variety of reading assessments.

A Quantitative Approach to Measuring Outcomes

To obtain a more accurate measure of student performance, anecdotal evidence and teachers' assessments should be supported by quantifiable data.

One of the most carefully assessed learning products is Autoskill, a comprehensive literacy program which has been continuously tested and improved over the past 20 years, notably in elementary and secondary schools in the southern US and the Caribbean, where dropout rates and poor self-esteem among failing learners are a common problem. Autoskill combines intensive teacher training with appropriate learning materials that provide personalized feedback to the learner. A significant advantage of this multimedia learning system is that learners can begin the program more or less regardless of their level of education or academic capability. Their progress in various subject areas remains confidential, and improvement of student comprehension is a key objective.

The computer is blind to race, color, age, gender, and disabilities—mental or physical, and as individual results and progress

are confidential, the risk of humiliation and mockery by peers is eliminated. Results have been surprisingly positive with middle-aged and mature adults in the Caribbean who missed out on an education when they were young. We are citing below reports available online.⁵⁶

The results from schools and districts are surprisingly consistent, with students showing an average of more than one grade level gain on their reading comprehension test in less than 10 hours of using the program. Students showed an average of 2.5 grade level gains in less than 25 hours in the program.

The company claims that regardless of the age, socioeconomic status, or number of students that are performing below grade level, their research-based software is designed to extend a helping hand to those students who most need it. In many countries, even though school roofs leak and textbooks are sadly out-of-date, school systems as well as governments are spending enormous sums of money wiring schools, purchasing and maintaining technology and software, and training teachers. Does this current emphasis on technology really make a difference in how much and how quickly students learn? A good deal of recent research suggests that it *does!* A study commissioned by the Milken Exchange on Education Technology and recently released by Columbia University discovered that West Virginia's use of educational technology led directly to significant gains in kindergarten to grade 6 students' reading, math, and language skills.⁵⁷

J. Costs

Hardware and Software

The basic components of ICT for educational purposes—personal computers, printers, scanners, projectors etc.—are becoming much more affordable and integrated, while their performance and reliability are increasing dramatically. To illustrate, in early 2002, a well-configured Pentium III 1 GHz personal computer (PC) with monitor cost \$1,500. At the end of December 2003, a similarly configured

⁵⁶ See <http://www.autoskill.com/results/>.

⁵⁷ See West Virginia Study Finds Direct Link Between Effective Use of Learning Technology and Higher Academic Achievement.

Pentium IV with 3 GHz or better processor could be had for less than \$500. The latter uses much less power, has four times the storage capacity, high-speed USB connections, much improved graphic resolution, and is easier to use (more user-friendly). A good 15-inch flat matrix monitor can be bought as an option for an additional \$250. While an array of more expensive and high-performance systems for both business and home use is being developed, systems entirely adequate for educational purposes continue to evolve in the direction of lower cost with higher performance.

New kinds of appliances and servers designed for the education market are emerging. One set of such instruments, tentatively dubbed the NIA⁵⁸ PC and the NIA Server, has price targets of \$300 for the PC and \$750 for a full server. The system is billed as a hassle-free, no-nonsense PC-Server combination. It offers a powerful Linux open source operating system, Apache Web Server, MYSQL, Mozilla and the WeTiki Web engine. The operating system and applications are written into ROM,⁵⁹ thus no continual upgrades are required, and there is no risk of viruses or Trojan infection, or from hacking or software corruption. The Web server is ready to use out of the box. It comes with some of the most powerful content management systems known and it is easy enough to use that the teacher or an assigned helper does not have to call in a technical expert.

Many personal productivity programs now come “bundled” with new PC units, or, if certified for educational purposes, can be obtained free or at very minimal costs. For example, Sun’s Star Office, which compares well to—and claims to be fully compatible with—Microsoft Office.

For more expensive high-end programs, larger educational institutions and networks in the developed world are often able to sign licensing agreements with software suppliers at greatly reduced prices, rather than paying off-the-shelf retail prices, an advantage rarely enjoyed by institutions in developing countries.

The strong ICT-oriented educational market in developed countries is compelling the more creative software suppliers to produce, for example, interactive programs that learn the user’s individual behavior and display information in a way that is more

⁵⁸ NIA for Neo Internet Appliance.

⁵⁹ ROM = Read Only Memory.

attractive to that individual. They can provide him or her with continuing feedback on performance, and automatically re-visit the more difficult items, without the learner feeling that it is work—it is simply more fun to learn!

Content Development and Production vs. Learner Access—the Cart or the Horse?

When considering investments in educational technology, program administrators tend to focus first on learner access, then on teacher preparation, and then on curriculum reform. While this can serve a useful political purpose (after all, providing learner access via technology is expensive and correspondingly impressive), many institutions in developed countries have placed at least equal emphasis on modernizing the “back-end”—that is, on the technology used to develop, store, manage, and distribute the learning content, either concurrently with or prior to increasing learner access. Resources invested in hardware, communications infrastructure, and computer applications cannot produce a return if the content is either absent or inappropriate. Creating an online course from scratch, especially for a top-level university with both institutional and personal reputations at stake in a competitive marketplace, is a long, labor-intensive process. Costs can vary from \$3,000 to \$100,000 and more.

In “*Managing Technological Change*,” Dr. Tony Bates of the University of British Columbia estimates that on average, one course consumes 30 days of a subject expert’s time, an additional 7 days for an Internet specialist, plus additional expenses for copyright review, academic approval, and administration.⁶⁰ A budget for course development, adapted from Bates, looks like this:

Subject Experts for 30 days at \$400 / day	=	\$12,000
Internet Specialist for 7 days at \$300 / day	=	2,100
Graphics and Interface Design for 4 days at \$300 / day	=	1,200
Copyright Clearance	=	700
Total Direct Set-up Costs	=	16,000
Set-up overheads 25% of 16,000	=	4,000
Department approval	=	<u>4,000</u>
Total	=	\$24,000

⁶⁰ See: <http://bates.cstudies.ubc.ca/>.

Bates is conservative. He assumes an experienced course author and hypertext markup language (HTML) specialist. He does not include any instructional design costs. Course design is straight forward and does not involve the development of any interactive media or course-specific Java programming. All of these would add significantly to the \$24,000 cost.

Delivery costs on Bates' model amount to an additional \$13,161, as follows:

Library	=	1,000
Server costs	=	300
Tutoring 40 students at \$220	=	8,800
Registration \$14 x 29	=	406
Administration \$28.86 x 40	=	1,155
Printed materials and postage	=	<u>1,500</u>
Total	=	\$13,161

To cover these costs, students in Bates' course pay \$695 in course fees, plus an additional \$177 for required readings. These figures are obtained by dividing the cost of offering the course over 4 years with an enrolment of 40 students per year over 4 years. Students must also cover some postage costs and obtain access to the Internet.

Almost all online course developers use the design model Bates describes. It posits a course being developed from scratch, using nothing more than a traditional university course or a good textbook as a guide. The course author typically authors all the online content, including examples and demonstrations, quizzes, and tests. The development cost suggested above does not provide for course-specific software or multimedia. The course is then offered to a small number of students over a limited time, resulting in course fees that are comparable to traditional university course fees for the first few courses. Future iterations or updates of the same course can be done relatively inexpensively as the basic elements are in place.

OLA experience differs from the Bates' model with respect to development assumptions and cost. To develop a typical OLA university course costs in the neighborhood of \$50,000, more than double that of Bates. However, these costs are all-inclusive of multimedia enhancement, design, and interactivity. More importantly, the annual costs associated with course maintenance and minor revisions are minimized since it is only course objects that are retouched, not the entire course. See the discussion above on Learning Materials.

Human Resource Development

The proper training of teachers and administrators is arguably the single most critical element in the successful introduction of ICTs in education. Without the full acceptance and support of key faculty and administrators, little progress can be made. Two primary streams of training must be differentiated: (i) training the teacher to use ICTs in the classroom, and (ii) design, development, and delivery of course content.

Learners can take a quick 15-day introductory program tailored to their specific needs. Upon completion they return to their classrooms or workplaces. They then have the option of pursuing advanced-level specialization at a later date.

Building Capacity in a Developing Country

What does all this mean to a ministry of education in a developing country? The costs are far beyond their budget, and the trained human resources needed to create a core group and build momentum are simply not available. If we take course development and delivery costs, such as those carried by Schoolnet India in building its own capacity, for instance, we have a scenario that could be useful in other nations:

International Instructors, 2 for 30 days at \$600 including course preparation and travel time: 600×60	=	\$36,000
Travel: \$5,000 travel $\times 2$	=	10,000
Accommodations: \$125 per day for 20 days $\times 2$	=	5,000
Software and materials for 30 clients	=	<u>10,000</u>
Total	=	\$61,000

In this instance, Schoolnet India was able to train a core group to a level of self-assurance and competency for about \$60,000. Using a pyramid approach—where those trained in turn train others, and with continuing support from the original foreign institutions, since 2000 Schoolnet has trained over 5,000 teachers and aides who are highly competent. Many of these are now pursuing advanced training in their chosen field with selected international institutions through DL.

It is worthy to note that Schoolnet India has spun off an affiliate, Learnnet, which specializes in multimedia course development. It has migrated the entire Indian K-12 curriculum to multimedia and

maintains it current. Most states in India have eagerly embraced Learnet's learning materials and its more compelling methodology. Learnet estimates that, with India's much lower labor costs, its course development costs for a program similar to the one used as an illustration are in the area of \$10,000, or one-sixth their original investment.

K. Conclusions

In developed countries, the use of ICTs in education is no longer considered an experimental enterprise. While research and experimentation continues, the use of ICTs in education has become mainstream, largely irrespective of social, economic, or geographical factors. In Canada, ICT is utilized everywhere in education—to some degree and in some form, in schools at all levels, from coast to coast to coast, including the in the high Arctic.

Developed countries have evolved their own set of international standards for design, delivery, and evaluation. ICT applications have been tried in hundreds of educational environments, at every level. Certainly there have been some failures and some partial successes, but there have been many clear successes, and few would question the value of utilizing ICTs for education, when properly applied.

One of the very great advantages of ICTs over earlier modes of education in both developed and developing countries is that once a country has developed an echelon of properly trained ICT-competent teachers, technologists, course designers, trainers, and administrators sufficient to create a social and political awareness and acceptance of the value of ICTs, and an adequate communications infrastructure, the incremental cost per student of expanding the system is, in relative terms, very low.

In Canada, and in most of the developed world, millions of people now enjoy opportunities that have never before been available. They are the first generation that can say: it no longer matters where I live or work, what is my age or health, my financial situation, or my educational level; I have access to another level of learning if I want it. It is time the billions in developing countries had the same opportunity.