TECHNOLOGIES AND LIFELONG LEARNING

VOLUME II: ATTACHMENTS

Report for the

Prosperity Secretariat

By

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ATTACHMENT A: Technologies & Lifelong Learning Case Studies & Short Examples of Present Uses

INTRODUCTION

The **purpose** of Attachment A is to illustrate:

- Innovative and creative approaches in using technology-based training for different componential elements of lifelong learning.
- Learning outcomes and attitudes of learners to the use of technologies in the learning process.
- Barriers, solutions and other information relevant to the use of technologies in education and training (these issues will be taken up in different parts of the analysis. See also Attachment B.)

Attachment A **consists of**:

A 1 Case studies of exemplary projects, using advanced technologies. Many of the projects are under development. Most will be evaluated, but "hard" findings are not always available as of yet.

A 2 Descriptive summaries of other relevant projects. Research findings are reported as available.

A 3 A copy of a recent summary of key study results of using videodiscs in training.

The materials presented:

- Highlight only a minute percentage of successful applications of technologies to learning. There are too many examples to name them all.
- Are based on existing reports, studies and evaluations. The information available, therefore, is not consistent across projects.

The cases and examples **illustrate how advanced technologies can address pressing priorities in lifelong learning** in Canada. It is critical to remember that our definition of learning technologies includes the environment in which learning takes place, as well as

hardware and software. Thus, when saying that advanced technologies can address certain priorities, we mean that technologies, using suitable software as well as a supportive learning environment, can bring about such results.

Specifically, they demonstrate that

- Primary and secondary students are better equipped for lifelong learning with the assistance of technologies in the learning process. This includes learning how to learn as well as foundations in reading, writing, mathematics, technology and group work. Thus, future generations will be better prepared to pursue lifelong learning.

- Learners who are not interested in pursuing an academic career can make a more effective link between learning and the skills which a person needs in work or in everyday life. Self-testing one's language skills against the language level required to pursue a technical education is one example. In addition, technology-based courses can help familiarize students with the kinds of technology they are likely to use in the workplace, e.g. with the help of simulators. Computer-based learning can also help familiarize students with rapidly changing technology.

- Technology-based learning can also help learners, who initially choose a non-academic career path, to make up missing components for an academic program.

- College and university education becomes learner-oriented, more closely linked to the world outside the learning institutions and more efficient through judicious use of technologies. This applies to on-campus as well as to off-campus or distance education. This is an important factor at a time when the majority of entrants will be older and will not have come straight out of secondary schools.

- More people can enter post-secondary education since restrictions resulting from physical space, class schedules or the local availability of relevant courses do not apply to technology-based off-campus studies.

- Individuals (young or old) who have left, or are on the verge of leaving, the formal education system without having acquired basic skills appear to be motivated to learn by using learning technologies. They also often achieve impressive learning gains in reading, writing or mathematics.

- Students enroled in continuing education and training (degree or non-degree) are major beneficiaries of technologies. The examples illustrate innovations and far-sighted initiatives by organizations and individuals who want and need continuing education.

- Benefits from the use of technologies in workplace training are at times dramatic in terms of cost-effectiveness. Reduced learning times with consistent or improved mastery of the subject, combined with flexible scheduling that often allows training to be integrated into a division's work day, are real benefits in business environments.

- Lastly, the examples illustrate experience with technologies and software to manage and administer distance education or self-paced learning. Such infrastructure is an essential foundation for growth of lifelong learning.

Highlights of the benefits of technology-based learning include:

- Demonstrated, at times dramatic, gains in learning.

- Consistently positive attitudes of learners, such as:

  - Young adults (including Inuit) who have left the formal system or are at risk. They appear to be motivated by the use of technology-based learning tools.

  - Older learners generally appear to like learning with the help of technologies.

- The opening up of more choices of content areas to learners, or the provision of higher quality learning content.

- Making access to learning flexible.

- Efficient administration of lifelong learning:

  - Testing (and self-testing), registration, mentoring and keeping track of progress of independent learners are facilitated by technologies.

  - A technological approach to capturing and updating an individual's "learning history" through a "learning credit card."

Other observations emerging out of the examples are:

- In the United States:
  - Partnerships are multiplying rapidly, which combine private enterprises and public institutions, to the apparent benefit of both--as well as that of learners.
  - Purely commercial ventures are also beginning to compete with public education institutions.
- Canadian institutions, organizations and entrepreneurs have impressive competencies in many areas highlighted above. They present a good foundation of experience upon which to build the future.

After a review of the cases and examples, it is difficult to avoid the conclusion that technologies are essential to learning and even more essential to implementing our concept of lifelong learning. It is impossible to avoid the question:

> **If technology-based learning has all the attributes highlighted in this Attachment, why is it not used more extensively?** Attachment B will explore barriers and attempted solutions to shed some light on this question.

ATTACHMENT A 1: DESCRIPTION OF "BEST CASES"

SUMMARY CHART OF THE CASE STUDIES:

The chart highlights points from the "best case" descriptions that make up Attachment A1.

Project Name	Project Description
Wahsa Distance Education Project	Access to secondary school completion for adolescents and adults in remote communities
Manitoba Satellite Network	Support for secondary schools in rural areas in specialized subjects
River Oaks Schools	Full integration of teaching technology & curriculum for grades 1 - 8
Northern Distance Education Project	Tutorial support for correspondence course students from remote communities, at the secondary school level; using technologies and computer laboratories
ISDN trial	Offers locally the full range of high school completion courses at electronic classrooms in community adult learning centres
Media-Integrated Curriculum Project	Offers a curriculum that integrates content and technologies: Grades 4 - 6
Pathfinder Learning System	Supports secondary school completion of adolescents and adults, using a computer-managed learning system
VI-CONTE	Teaching French as a Second Language, for all levels, using interactive videodisc
Learning Credit Card	A "Smart Card" to help people match learning to their needs
Télé-université	Complete environment for distance education at the post-secondary level, based on telematics
Videoway	Collaboration between a cable operator and education groups; interactive cable system for general & non-formal education at all levels

PROJECT: Wahsa Distance Education Centre
Sioux Lookout, Ontario

Overview:

Wahsa is a continuing distance education program of the Northern Nishnawbe Education Council of the Nishnawbe-Aski Nation with private school status, providing accredited secondary school programs for adolescents and adults. Wahsa offers its courses in 23 isolated communities north of the 50th parallel in the Sioux Lookout District of northwestern Ontario.

Wahsa began operations in the school year of 1990-91 and currently offers 34 secondary school courses from grades 9-12 for adolescents who want to wait until they are older to leave home, for adolescents who have tried southern schooling and returned, and for adults working towards secondary school completion. Most of these Native communities have K-8 on site but lack secondary school facilities.

The program is financed by Indian and Northern Affairs Canada for pre-implementation and is currently on a fee for course basis. The Ontario government contributes through Wawatay Native Communications Society and local communities provide learning centres and co-ordinators.

Principal Technologies:

Wahsa programming is delivered via satellite radio broadcast through the Wawatay Native Communications Society. Wawatay's FM signal is broadcast via a TVOntario Audio subcarrier on Anik C. Currently the signal is split and Wawatay Radio broadcasts on one mono bandwidth and Wahsa on the other.

Students in four communities have in-watts telephone lines and can speak simultaneously to the teacher. Other communities have convenors for high quality teleconferencing capability. Each learning centre has a computer, VCR and FAX facilities.

Curriculum and Instructional Strategies:

The grade 9 to 12 core subject areas are taught, as well as Native language and history, art, etc. There are two instructional models:

1. Semestered radio courses (two hours weekly with six to eight additional hours of study required per week). These courses are reinforced by tutoring and locally provided resources.

2. Correspondence courses offered through the Independent Learning Centre, Ministry of Education, Ontario.

Radio courses are produced in Sioux Lookout in Oji-Cree and Cree (or interpretation available from English). Assignments are submitted via air on the Wahsa Express.

Findings:

A number of planned and unintended outcomes have been noted.

1. Courses are also being accessed by non-registrants through broadcast.

2. Adolescents can remain at home and continue education.

3. Enrolment is steadily increasing, as are course offerings. Completion rates are variable, but on the rise.

Barriers:

A number of barriers to development and implementation are evident. Some suggestions have been made on the means to overcome them.

1. Native learners are considered to be visual and kinesthetic (hands-on) versus aural. Wahsa is currently exploring the possibility of using telewriters (computer tablets) and datacasting via the Vertical Blanking Interval (VBI). Also, live television is a possibility through Wawatay's transportable uplink system.

2. There is a need for further training of co-ordinators of Learning Centres. A college based course specializing in training of co-ordinators of Learning Centres might be a solution to this training need. It is also essential to train teachers to use technologies appropriately.

3. Access to appropriate space in the communities is essential, specifically a multipurpose learning centre including library and daycare facilities.

4. How education fits with community priorities is an ongoing issue, when basic housing and water issues are still to be solved.

5. With respect to funding, there is the question of acceptance of a small community-based project by the corporate sector.

6. Copyright issues remain an important concern in the development of courseware for advanced technologies.

How this program fits into a lifelong learning culture:

1. The technological system can be used in the future for adult upgrading, on-the-job training of community workers, and professional development for teachers, nurses, etc.

2. It has important implications in promoting networking and sharing among those living in isolation.

3. Disadvantaged adults who had no opportunity to complete secondary school can now do so.

PROJECT: The Teacher-Mediated Program Manitoba Satellite Network

Overview:

The Teacher-Mediated Program involves the provision of curriculum to secondary schools that do not have teaching resources in the specialist areas. The program is funded by the Government of Manitoba, Ministry of Education, Distance Education and Technology Branch via the Manitoba Satellite Network on a fee per course basis. Satellite time is subsidized by government. The program involves 72 schools throughout the province, particularly in rural areas. Currently there are 600-700 students enroled in the various courses. This is the third year of a pilot project.

Principal Technologies:

The project involves audioconferencing via dedicated lines. The satellite network (transmitted via ANIK E2) includes 72 secondary school locations and 20 cable outlets. Four studios originate programming, including one in Brandon, which is connected by fibre optic cable to the uplink in Winnipeg.

Capacity exists for computer conferencing through MINET, a provincial network.

Curriculum and Instructional Strategies:

Regular secondary courses in specialist areas from the curriculum, e.g. calculus, carpentry and computing. Students participate in small groups at remote school sites.

Rural teachers adapt these courses using video, audio and computer software. Audio teleconferencing is done on a twice weekly basis per course with once-a-month live satellite broadcast--two-way audio and one-way video.

Findings:

A number of planned and unintended outcomes have been noted.

1. Prior to the advent of the Network, completion rates in correspondence were approximately 25%. Currently they are in the 70-80% range.

2. Continuing enrolment declines in small rural schools have increased the need for alternatives using technology.

3. Exposure to use of high technology is causing an increase in demand and reducing traditional educational and training costs.

4. This type of delivery requires a learner-centred support structure.

5. The advent of a province-wide "classroom" allows for cost-effective student exposure to a wider range of subjects.

Barriers:

A number of barriers to development and implementation are evident.

1. As a government program, outside funding opportunities are limited.

2. Local institutions need to adapt better to newer delivery systems in terms of provision of facilities and human resources. Teachers currently involved are working in addition to their regular workload.

3. There have been technical problems with implementation.

4. Scheduling of TBT courses has been difficult. There is a need for consistency in scheduling.

PROJECT: Halton Board of Education, River Oaks School Oakville, Ontario

Overview:

River Oaks School, which opened in 1990 and has 620 students, is a K-8 public school in which technology has been totally integrated into the school from Grade 1 on and the teaching and learning process has been restructured accordingly. Built with the integration of computers in mind, it is architecturally sensitive. Its objective is an attempt to address the knowledge and skills required for education in the twenty-first century. This is the only Canadian school currently in operation funded by the Apple Canada Educational Foundation.

The major supporting partners are the Ontario Ministry of Education, the Halton Board of Education, and Apple Canada. Other sponsors include Northern Telecom, Sony, etc.

Principal Technologies:

The school is equipped with over 200 MACs (with two main computers with file servers) and related equipment, including scanners, CD-ROM, videodisc (all classes wired together) and modems for access to external databases. By September 1992 these technologies will be operational in all classes throughout the school.

Key software applications include ClarisWorks and Hypercard.

Curriculum and Instructional Strategies:

The K-8 curriculum is divided into four parts--literacy skills, lifeskills, the arts, and creative applications--with three main units of study--Human Relations, Science and Technology, and Global Awareness.

The children are viewed as knowledge workers. The educator's role is to provide access to and to manage and facilitate the learning process (to engage, enable and empower). Children's learning styles and need for individualized work are a focus. The same teacher follows students for a block of years. Materials are produced by students and teachers as well as externally, using a multimedia approach.

Findings:

There are five major research projects in progress at the schools--both curriculum-based and process-oriented.

However, a number of planned and unintended outcomes have been noted.

1. There is a high degree of engagement of children in the learning process. They seem highly motivated.

2. There has been a decline in discipline problems.

3. There has been a change in teachers' instructional strategies.

Barriers:

A number of barriers to development and implementation are evident.

1. There are a number of structural barriers, including existing guidelines at both board and ministry levels (e.g. policy regarding number of telephone lines permitted).

2. There is some resistance to change at both the board level and among teaching staff.

3. To date, there is a shortage of resources to support their learning resource requirements.

PROJECT: Northern Distance Education Project (NDLP) British Columbia

Overview

The goal of this pilot project, ending in June 1992, is to utilize new technologies to increase access to educational opportunities in remote communities. Tutorial support for traditional correspondence courses at the secondary school level is being provided at seven sites; the project also fills the need for computer laboratories in rural schools.

The NDLP is a co-operative initiative of Northern Lights College; the Open Learning Agency; the Ministry of Advanced Education, Training and Technology, The Correspondence and Distance Learning Branch; the Fort St. John Regional Correspondence School; the Educational Technology Centre; and the Stikine and Fort Nelson School Districts.

Principal Technologies:

The technologies include the Optel telewriters and audioconferencing through ProvNet, the provincial dedicated telephone line system. There is also on-line computer-based training using PLATO, housed at the OLA computer in Vancouver. In addition, there is access to a PALS and PATHFINDER lab at one site.

Curriculum and Instructional Strategies:

The project is aimed at secondary school students, particularly students at risk and adult students. The subject matter of the pilot includes correspondence courses with tutorials via audioconferencing as well as Telewriter support and computer-based training to fulfil need for a computer laboratory in rural schools.

Local educators have been trained. The project has a lot of support built into its design. Learners are in designated sites in schools, either individually or in small groups.

Findings:

An evaluation of the program is in progress.

One obvious finding is that dedicated telephones lines are essential to success, given the amount of online time required.

Barriers:

A number of barriers to development and implementation are evident.

1. There are jurisdictional barriers within the educational system between public schools and colleges.

2. It is essential to have a source of funding to continue a successful pilot project on an ongoing basis.

PROJECT: ISDN Trial
Vancouver School District

Overview:

This pilot project employs ISDN telecommunications technology and multimedia workstations to connect four VSD community-based adult learning centres in Vancouver in an "electronic classroom," providing low-enrolment courses to students unwilling to leave their neighbourhood to take high school completion courses.

The pilot is scheduled for two years from 1991 through 1993 and is a partnership involving the Open Learning Agency, Vancouver School District, the BC Telephone Co., and MPR Teltech (an R&D subsidiary of BC Tel).

Funding comes from the federal Department of Communications and the B.C. Ministry of Advanced Education, Training and Technology.

Principal Technologies:

The pilot is based on BC Tel's ISDN system connecting three of the learning centres, allowing high speed voice, data and image transmission. The MPR workstations consist of a PC, a speaker, a microphone, tablet, TV and VCR. One station included a colour scanner and laser disc player.

Curriculum and Instructional Strategies:

The content is two courses that are part of the high school completion program for students at risk and adults.

A teacher is present at one of the centres and simultaneously instructs the four groups, using slides displayed on the computer terminals, lectures and, on occasion, other media applications available through the workstation.

Computer communications are synchronous and students can participate in a multi-site audioconference.

Findings:

A formative evaluation of the program is in progress. In part, the evaluation is looking at the relationship between conventional and mediated classrooms.

However, a number of planned and unintended outcomes have been noted.

1. There have been a number of recurring technical problems with state-of-the-art technology, which can impede learning.

2. Students appear willing to use technology.

3. Teachers are not using the technology in an innovative manner. They are replicating classroom strategies.

Barriers:

A number of barriers to development and implementation are evident.

1. Traditional school infrastructure, including physical plant, scheduling, teachers contracts, etc., is not easily transferable to the more flexible model allowed through technology.

2. Instructors require training to design classes effectively using new technologies.

3. There is a need for ongoing on-site technical support, which the school board must provide.

4. There is concern with preparation time and quality of instruction using workstations.

5. There are serious copyright considerations with respect to adaptation and development of materials for new technologies.

PROJECT: Media-Integrated Curriculum Project Carleton Roman Catholic School Board, Ottawa

Overview:

The goal of this project is to provide curriculum that integrates technology with content to 4,000 students (and 174 teachers) in Grades 4 to 6 in 34 schools of the Carleton Catholic School Board.

The project has been operational for three years. The first year was a pilot project with 6 classrooms. The last two years have been ongoing with 90 classrooms in 34 schools. Another 6 classrooms will be added next year.

Computer equipment and accessories have been supplied by provincial grant (GEM) and a corporate sponsor, Unisys. Other capital equipment and staff development time is provided from the Board budget.

Principal Technologies:

Computers (Icons and PCs), laserdisks, videos, audiotape recorders, calculators and spell masters.

Student have 6 centres available to them in each classroom: a viewing centre (laserdisks, videos and computer); reading centre (textual material); writing centre (computer with word processing); concrete centre (hands-on experimental materials); speaking-listening centre (audio tapes and tape recorders); arts centre (visual arts, drama and music).

Curriculum and Instructional Strategies:

To date, 18 modules have been created in English, Mathematics and Environmental Studies for Grades 4 to 6 including ESL students.

The objectives are to integrate technology into curriculum; use mastering learning techniques; use small group co-operative learning; and provide individualize learning.

Two full-time teachers developed units with the assistance of a staff computer programmer and writers who were teachers on secondment. A unit takes 4 to 6 weeks to develop. Each unit takes 6 weeks for students to complete: the first two weeks the students work as a class, the next two weeks in small groups, then the last two weeks on individual assignments. Each unit has a classroom-based curriculum, small group curriculum, tests, assignments (at various levels of difficulty), commercial software, video audio tape, print material and hands-on material.

A computerized Instructional Management System tests each student and then prescribes the appropriate level of individualized assignment. Assignments are at four levels of difficulty. A core of required skills must be mastered by all the students. Optional skills can be mastered as well.

Findings:

No specific findings were noted at this time.
Evaluation is being conducted internally--first year of a two-year evaluation.

Barriers:

A number of barriers to development and implementation and the means to overcome them were suggested.

1. The level of commitment of senior officials is a key to success. This program was initiated and supported by the Director of Education and was implemented at board level.

2. Resistance from teachers to new technology and change was anticipated. To overcome this, teachers were involved in the development of curriculum. In-service training was provided to teachers. Technologies were set up for classroom teachers by the project team. The project team provided training to teachers and students on how to use equipment. Ongoing support is available.

PROJECT: Pathfinder Computer-Managed Learning System

Overview:

This Computer-Managed Learning system is presently being used for basic life skills for young adults, adults and school drop-outs. Over 15,000 learners use the system at present. Ninety systems have been sold to high schools, adult learning centres, community colleges, Native friendship centres, Indian reserves, technical vocational institutes and non-governmental organizations. Almost 50% of all sales have been in B.C. (as part of Year 2000 initiative); the rest have been across Canada and in Washington State.

Pathfinder's Management Software is a management tool for designing, organizing, assigning, tracking and evaluating learner progress along individualized learning paths in a self-paced, self-directed, competency-based learning environment. Pathfinder/Formatique software manages the system's learning outcomes, assignments, test items and provides learners with access to an educational resource library of some 2,000 items, including books, kits, videos, audio tapes, software and other tools appropriate for adults.

Pathfinder is sold as a commercial product by Pathfinder Learning System Corp. This company is 78% employee-owned with the rest of the equity from venture capitalists. A turnkey system costs $135,000 the first year plus the cost of the hardware. Ongoing costs are $6,000 per year for licensing and ongoing support and training.

Principal Technologies:

IBM PS/2 and Dataflex, which is a fourth-generation C language. The system is based on the IBM PS/2. A typical installation will need eight networked computers. The software has an open architecture with users able to modify or add to the curriculum.

Curriculum and Instructional Strategies:

Five modules have been developed to date. New modules are being planned. Current modules are being constantly updated by users and the company. Modules have been developed in reading and writing, mathematics, science, social science and employment skills.

The system manages the curriculum by testing students and providing individualized assignments based on the results. The first test is for the appropriate reading level. The learning is self-paced and is based on masterly learning. Over 2,000 multimedia resources are included. These include books, videos, audiotapes, commercial educational software and kits. If necessary, the system can be interfaced with another computer-based system PAL (Principles Adult Literacy) to provide literacy training. The system is sold as a turn-key operation. Computers, software, resources are all included. In-service training is provided as well as free telephone support. Typical student teacher ratios are 25 students to one teacher and one TA. However, one installation has 1200 students to three teachers and one TA.

Findings:

Findings from a High School in New Brunswick show a retention rate of ninety-five percent over a two year period. The majority of the students had been assessed as "at risk" by guidance personnel. Standardized test results for the 1990-91 were also remarkable. Average grade equivalent gains are: for mathematics +2.3 years, for Reading +2.0 years and for Language +2.4 years.

A thirty year old student from Ontario states that he will have completed 12 Ontario Secondary School credits between January and August 1992 and expects to go to community college in September.

Barriers:

1. Pathfinder offers a national generic core curriculum that integrates the curriculum guidelines of all the provinces and territories which offer English as the first language. It has been criticized for not offering a specific provincial curriculum. An organization in Newfoundland is developing a provincial curriculum basis from

Pathfinder materials to be used by others in the province, Formatique may be faulted to a lesser degree.

2. It is not always easy to identify local curriculum, as packaged by Pathfinder, within a national generic core curriculum.

3. The Test Bank needs to be enlarged and there have been requests for additional assignments.

PROJECT: VI-CONTE

Overview:

An Interactive videodisc designed to teach French as a second language in a French-Canadian cultural setting. The CBC film *CRAC!* is used, as well as slides from legends and photos.

Test sites: San Diego State University; seven colleges in the U.S., University of Guelph and University of Calgary.

Level: adult, may address other; also self-learning.

Principal Technologies:

IBM-XT or PS/2, Sony Videodisc player 1000a, 2000 or Pioneer 2200 to 8000. 3 tracks: 1 video, with the film CRAC! (15mn) 1 audio, with CBC original soundtrack, 1 audio, with narration.
Software for further interaction between users and material is available separately.

Curriculum and Instructional Strategies:

Vi-conte first presents a video story with images and sound, then gradually introduces the language needed to tell the story. The audio is with both standard French and Quebec French.

The project is inspired by Nord's and Piaget's interactionist view of language learning and is in three phases: 1) Observation, for beginners; 2) Narration, for intermediate level; 3) Reflection, for advanced level.

Findings:

From an experiment conducted during Beta-test under Prof. Tom Cox at San Diego State University, professors said it was excellent and students liked it very much. Students had access to the materials on a volunteer basis outside the classroom and suggested that it be integrated into the regular course.

Barriers:

1. Needed is a ratio of one station for one or a few students

2. Professors need to spend a fair amount of time to integrate the videodisc into their course and curriculum.

3. It is difficult to convince faculty to integrate the materials into their own course.

4. Students find the material too old-fashioned and prefer a more up-to-date look and sound track.

Link with lifelong learning:

Vi-conte can be used in any learning context, formal or informal, integrated or collateral, with heterogeneous students (adults or young, any first language). Its content is classical and does not become obsolete. Possible expansion: adaptations (soundtrack or software) for specific clients or port onto a more advanced technology, CD-I or DVI, for more flexible uses.

PROJECT: Learning Credit Card

Overview:

The project developed a smart card to help people match training to their needs, and to create a better path for personal development. The card stores a simplified adaptive model of the learner, along with a recommended database, recommended course program, and other useful information. The card supports learning and the management of learning. The project has been ongoing since 1987, with a five-month study funded in 1989 by the U.K. Training Agency, together with Guildford Educational Services.

Principal Technologies:

Smart card, preferred to a disk or other memory device for control of personal information, "a powerful icon of ownership" of personal development.

Curriculum and Instructional Strategies:

Based on competency approach, states which competencies the individual already possesses and which ones are missing. Steps for recommending routes towards the desired set of competencies are:

1. Exploration of learner's goals.
2. Assessment of what the learner knows and can do.
3. Consultation on training programmes to meet needs.
4. Design of program tailored to meet learner's needs and learning style.
5. Updating of learner's progress through program stored within the card.
6. Advising of learning activities and resources needed.
7. Keeping records of student performance.

Findings:

The card reduces the cost of training needs assessment and of devising a training program; the operational cost is £10 per year per student. It is currently being implemented for use by 400 managers; trials for clerical and technical training, and educational applications are planned.

Link with lifelong learning:

The card empowers people, individuals as well as in companies; it allows individually adaptive follow-up of the learning process, as well as the integration of assessment, delivery and management of learning.

PROJECT: Télé-Université

Overview:

Télé-université is a complete environment for distance education based on telematics: teletutoring, access to software and databases, electronic mail, teleconferencing, videoconferencing, testing, course and curriculum management.

Principal Technologies:

Télé-université offers access to servers INFOPUQ and UNITL through its network when possible; otherwise it establishes connection with the distant student via EDUPAC or DATAPAC. An experiment was conducted in 1990-91 with the course "Téléinformatique et applications télématiques." In the project highlighted here, students are required to have access to a minimal configuration: micro-computer, modem, and communication software (modem-loaned when needed).

Curriculum and Instructional Strategies:

With the content being itself telematics, students were asked to practise and learn theory at the same time. Eight teleconferences were organized and animated by a tutor (including a "café" for socializing); electronic mail was used for group work and communication with the tutor. Information and testing were available at any time.

Findings:

Fifty-five students out of 98 answered a detailed questionnaire on learning about the system, tutoring, content, material and all telematics-based activities. Statistical analysis of the results shows that students have a positive perception of the telematics environment, and that most technical problems were due to low-level telecommunications software. Students reported that collaborative work was useful, communication with the tutor was efficient, and they liked electronic testing. As an outcome, the model of telematics-based tutoring has been fine-tuned and adopted for other courses in the field. Most students could do group work and be autonomous with minimal tutor assistance. The experiment revealed the need to have different types of tutors specialized in 1) content, 2) the pedagogical use of the system, 3) the technical use of the system; this results in greater effectiveness of tutors and reduces the tutor time needed.

Barriers:

1. For students, access to a minimal computer configuration is necessary.
2. For the Télé-université, the cost of technical support is a barrier.
3. The need to maintain easy access to the course with a minimal configuration for students led to low-level interfaces and slow telecommunication, which affected the success of the course.

Link with lifelong learning:

A model has been tested, fine-tuned and adopted for interactive asynchronous learning at a distance and is available to students of any age, so that they can study where and when they can or want. The course gives students university credits. Students will need better access to computers and to telecommunications links.

PROJECT: Videoway

Overview:

An educational unit of Videotron cable television, as part of Videoway services. The pilot experiment was based on collaborations with the Commission scolaire des Mille-Isles, Ecole Secondaire Vaudreuil, Centre collégial de formation à distance, Hôpital Ste-Justine, Fondation Paul Gérin-Lajoie. It is part of a three-year plan of corporate involvement in developing quality educational products and is based on a study by the University of Montréal, with clearly expressed needs for educational services. The company strategy is to develop products jointly with schools to ensure pedagogical quality and acceptance, to validate products and then distribute them. Videoway programming addresses preschool children and also children with learning difficulties, students at primary, secondary and college levels, and adults.

Principal Technologies:

Videoway interactive cable television; 22 products and services: educational games (tours d'Hanoi, Classons), information (Journal 7-15), school activities (dictée PGL, Croco-maths).

Curriculum and Instructional Strategies:

These have been developed jointly by Videotron system designers and school teachers and are based on simple interactions allowed by the interface; they include some well-known educational games (Hanoi tower), some original products developed for use as support to class activities, and one product directed at literacy. A special project with Hôpital Ste-Justine, for children with learning difficulties, assists in the acquisition of a number of skills, including visual discrimination, classification, logical-temporal organization, as well as visual and auditory memory. French and mathematics software for college level is currently being developed for distance education jointly with Centre collégial de formation à distance.

Findings:

After two pilot projects: good acceptance and willingness from educators to collaborate further. For example, at Mille-Isles, Videoway terminals have been installed at the CEMIS (Centre d'enrichissement en micro-informatique scolaire) for developing pedagogical activities using Videoway in class. A study by Loto-Québec indicates that Videoway games are perceived as much more educational than others like Nintendo (85% of respondents), and that the arrival of Videoway games in the home reduced the use of Nintendo-like games (52%). Other findings will become available since the Université de Montréal is continuing its study on Vidéotron.

Barriers:

1. Low-level technology, limiting in terms of interaction and general performance. Better interface currently under development at Videotron.

Link with lifelong learning:

Videoway's initiative in education is a major strategic move by a company that is predominantly in the entertainment business. The potential impact, with very well-accepted and wide-spread technology, is large; Videoway can reach a very large number of people, using simple interactions. With quality products, there is great potential for reading readiness and readiness to learn, etc. It also provides an opportunity for children to learn at home with their parents.

ATTACHMENT A 2: Descriptive Summaries of Other Relevant Projects (taken from a vast number of possibilities)

Adult Basic Education

Learning Issue	Benefits/Outcomes	Technology & Learning Support
Literacy for adolescents and adults (reading below grade 6) [Newfoundland & British Columbia].	Newfoundland: .80% increase in reading, writing, typing; .Students enjoy using computers to learn; .Students motivated to work past scheduled times; British Columbia: .Significant increase in participants' literacy levels; .Average gain results were higher for adults than for high school students; .Significant gain was also recorded in the areas of self-worth and confidence.	.Computer-assisted interactive videodisc system (PALS); .17 weeks, 4 1/2 hours per day; .Difficult to make adjustments to program locally.
Pre-vocational basic skills, for adolescents, drop-outs, with limited English language [California].	.Gain over 4 grades in word attack skills; .3.6 grades gain in nine hours on program; .Technology cost per student as low as $45 a year, spread over five years and one instructor for 80 students; .Canadian product (by Autoskills).	.Computer self-paced learning in a networked environment; .Software handles general administrative tasks, student registration, information storage; .Mathematics software available as well.
Basic skills upgrading, job skills and search for disadvantaged youth, post grade 8 [Nova Scotia -EIC funded].	.Computer had important motivational value for the students.	.Computer-based system (PLATO) with comprehensive materials and curricula, including student monitoring and report generation;

		.Materials can be adapted by managers and instructors; .Delivery is combined with face-to-face and print.
Academic upgrading, job readiness, special skills for unemployed adults in Inuit communities in the North.	.Computer-assisted learning did not result in a major difference in rate or magnitude of learning gains, as measured by Test of Adult Basic Education; .It did contribute to significant increases in enrolment; .Enrolment of a wider variety of students; .Notably better success in communities where previous adult education programs had failed or had done poorly; .Improved retention of students, and a greatly improved self-image for participants; .Better image for adult education in the participating communities; .Many students intend to pursue technical training in computer field; .Employers were interested in participants because they have computer skills.	.Ten to 12 computer workstations per community, networked into a local area network; .Pilot tested (two years) in seven Keewatin communities; .PLATO package consisting of Adult Basic Skills, High School Skills & business applications; .Findings reported are from year one.
Unwell students, not able to attend school over long periods.	.Grade 7 through secondary, younger students considered if they can use equipment; .Resource teacher and parents essential to success.	.Computer network, fax, and telephone to feed support materials to the student and to communicate with school, other students and other resources.

In-house/In-service

Learning Issue	Benefits/Outcomes	Technology & Learning Support
Consistent and high-quality training for people at over 80 locations. The employees and contractors participating in the program were linemen, electricians, tree cutters and technicians [British Columbia].	.The company's evaluation found that all workers, no matter their level of computer expertise, found CBT fun, informative and interesting; .All participating workers passed the mandated provincial safety tests; .Compared to the traditional classroom-based approach, the CBT method cost less, since it took learners less time to pass the test and it reduced supervisors' and trainers' time; .The program is based on existing hardware; .The course can be used every two years for safety re-certification, as it can easily be adapted; .For this reason, the course is being marketed to other electrical utilities; .The success of the program led BC Hydro to introduce CBT in a number of other areas.	.Computer-based training using existing computers as hardware platform; .The courseware was distributed on discs, as costs of electronic distribution would have been too high, due to the high graphics content of the materials; .Computer links are used to look after the administrative aspects of the courses, such as signing on and off, providing feedback on results; .This latter feature resulted from feedback by supervisors who found that the new, decentralized approach to training added significant paperwork to their regular jobs.
Retraining and continuous upgrading for 14,000 employees of BCTel is carried out as a result of changing technologies and services. With 35% of the company's employees located across the province, better access to training is	.Compared to the traditional lecture style, CBT training improved test scores by 13% and halved the time required to achieve results; .After initial resistance, learners-- in particular older learners--reacted positively to the self-paced	.The CBT course is taken at the learning centre, and is overseen by tutors who formerly were instructors; .The company also developed an integrated communications software system to automate course administration and

also a motivating factor [British Columbia].	individualized nature of the CBT materials; .After initial resistance, most instructors liked the changes which the introduction of CBT made to their jobs, which changed to tutors or courseware developers; .CBT requires high initial investments and was a hard sell in the company. However, a pilot project demonstrated that the initial investment would be paid back in two years and would reduce costs of training after that.	management, an important aid to course administrators; .This CLAMS system can be accessed by customers throughout the province.
To upgrade staff and attract school leavers with higher educational levels into the construction industry, it is necessary to combat the shrinking supply of skilled trades people, and of qualified new entrants. PCL Constructors initiated an in-house program at district offices to train in communications, teaching and supervisory skills [Canada-wide].	.In-house evaluations are under way; .Generally, the independent study method has been well-liked and the use of technology does not appear to be an obstacle from the participants' point of view; .Cost studies undertaken by the company revealed that a delivery system based on classrooms and lectures at all 15 district offices of PCL would have cost 40% more than the technology-based training approach.	.Interactive videodisc stations are set up in learning centres at 16 district offices; .Participation in most courses is voluntary and organized at the district offices; .Staff take the courses at slow times, including weekends; .Participants who complete a course are awarded an in-house certificate; .Supervisors receive some support to help staff use the new knowledge in their work.

Computer-based in-service training of immigration officers. The project was part of an exploration of Training Canada to investigate the use of computer-based training in government departments.	.Computer-based module significantly facilitated learning. Subject matter: use of airline ticket as examination tool; .Attitudes very favourable toward computer-based training.	.Computer-based module with videodisc; .Pilot only; .Use at learning centre.

University/College - On Campus Model

Learning Issue	Benefits/Outcomes	Technology & Learning Support
Teach graduate-level physics and chemistry classes remotely. [Universities of Guelph & Waterloo].	.Reduces hours of commuting time per week in programs offered jointly.	.Two symmetrical TV channels for voice, data and video between classrooms on each campus.
Make English students fully computer literate through a "course-on-a-disc" in literary criticism. [University of Guelph].	.More comprehensive and varied study materials than text-based, with additional remedial and help functions; .Improved quality of essays; .Livelier classroom discussions, as most students will have had access to assigned reading; .Expected: better employment opportunities for fully computer-literate English students.	.Computer program that includes all required reading, references and assignments; .Students submit assignments on-line, get help via E-mail.

Individualized tutorial in biomechanics. [McMaster University - special citation in "101 success stories of Information Technology in Higher Education" [EDUCOM, US, 1992].	.not available	.Computer tutorial that illustrates complex effects of muscle mechanism on human movement.
Developing Chinese and Japanese writing skills. [University of Toronto, citation/ see above publication].	.not available	.International electronic mail exchange between University of Toronto and Tokyo University; .Students develop writing skills co-operatively.
Integrate business school curriculum with advanced information systems. [Dalhousie University, citation see above publication].	.not available	.All faculty have microcomputers, students have large laboratory; .All are connected to internal E-Mail system and to global scientific networks; .Importance is integration of curriculum with the technology.
Practical exercises to support farm management studies. [Cornell University, citation see above publication].	.not available	.Computer-based program to model management of cattle herds.
Individualized, self-paced technical studies with open entry/exit. [SENAI, Brazil]	.efficient use of space and facilities; .drop-outs and fast learners can proceed or be replaced with new entrants.	.Innovation is largely in the management of the learning process.

University/College - Distance Education

Learning Issue	Benefits/Outcome	Technology & Learning Support
Full graduate-level degree course delivered to worksites. Engineering and computer science courses are delivered at corporate and institutional learning centres. Non-credit programs are also offered [National Technological University, U.S.].	.1,000 graduate students after six years' operation; .Expects to be one of top 10 universities awarding M.S. degrees in engineering fields; .39 top engineering schools offer about 700 courses and award credit to students; .University is paid for largely by high tech companies who wish to upgrade employees part time, to keep them productive full time in the company; .56 corporate sites and almost 200 other sites across the country sponsor NTU; .1/3 students watch sessions live, the remainder use tapes; .Turn-around time for sending and grading assignments by mail was a problem until fax and other electronic support were introduced.	.Satellite-delivered video courses; .Subscriber organizations provide on-site infrastructure, including satellite reception, library, E-mail, course materials, computers; .Students may interact with professors by telephone, E-mail, fax, interactive broadcasts; .Electronic bulletin board and on-line database is used to gather data about the classes.

Create a virtual networked classroom for open learning. Support an open learning strategy based on multimedia and networks for several universities' continuing education activities. To feature a co-operative learning system and flexible pedagogical workshops. [Université de Lille, France].	Results of an experiment in 91-92 to come.	Presently, SIMFI (Système Interactif Multimedia pour la Formation Individualisée) supports 10 CURE centres (Centres Universitaires de Ressources Educatives), each with a server and between 8 and 24 stations, all connected with a regional server with a bank of courseware; connection from home or workplace. Another development aims at multimedia real-time teleconferencing.
Laboratory for mathematics and science education, for teacher training and research. Laboratoire informatique d'évaluation et de didactique des mathématiques et des sciences [Université de Montréal-IBM-Du Pont Can.-Commission Scolaire Sainte-Croix].	Not available.	Thirty-eight personal computers in network, two labs (university and school), Laboratoire IBM 7694, Ensemble du mathématicien (software for math learning).

Commercial Ventures

Learning Issue	Benefits/Outcomes	Technology & Learning Support
ELECTROCOM, a commercial learning centre offers for a fee access to a large number of technology-based training programs. Training programs are offered in management, marketing and selling, computer-related, health care, technical areas, instrumentation, safety and	.No data is available on the success of the venture, but according to the company, a number of major corporations have signed on to the service; .The benefits to client companies are that they can benefit from training that uses high technology,	.A learning centre, commercially operated by ELECTROCOM in Montreal, provides access to courseware based on interactive videodiscs; .The learning centre operates seven days a week, until late into the evening; .Customers buy training vouchers in blocks of time,

medical and social fields. The target groups are employees of companies in the Montreal area.	without having to invest in the hardware; .Further, they have access to a range of courseware, which would be costly to purchase in-house, unless sufficient numbers of employees need training in that area; .The programs are not linked to formal tests. However, basic data are collected on each student, such as the amount of time a student spent on a task.	from 20 to 350 hours of training, valid for the period of one year; .The vouchers are valid for different employees of a company and for the range of courses available at the centre.
Mobile automated learning labs (MALL), supported by a utility holding company, provide literacy, reading, mathematics and language arts skills. Students may earn up to a General Education Development certificate (equiv. of high school diploma); The corporate sponsor is Entergy, a utility holding company (New Orleans) that recognizes that a literate work force is critical to its profitability. Locally, the program is supported by community-based agencies.	.Privacy spares adult learners embarrassment, encourages them to seek help; .The partnership makes profit for the software provider and makes economic sense for the corporate sponsor and educational sense for the participating community agencies; .The community agencies will own the equipment and software when they commit to a five-year literacy-skills program and achieve a set of performance standards.	.Mobile vans with eight to ten work stations, equipped with interactive video laser discs; .Touch-sensitive interaction with materials for learners with very limited reading skills; .On-camera interaction with tutors; .The courseware is developed for adult learners.
Mind Extension University (ME/U), a division of a cable TV company, brings credited high school and college courses to individual cable homes. The courses originate from	.No data available, but learners reportedly gain GED standing. .Universities such as Maryland University College (Bachelor's in Management) and Colorado	.Satellite to cable service, started in 1987 by a major U.S. cable operator; .ME/U handles registration, admissions, assigns voice mail number, provides tape service;

18 colleges and universities in the U.S.	State University (Master's in Business and Ph.D. in Teacher Education, Staff Development) find association with ME/U worthwhile and offer degree programs via ME/U.	.Unencrypted service reaches 12 million households, 24 hours a day, every day.
T-IN Network brings specialized credit courses to school districts in 29 states. The network started in 1985. Content is geared toward K to 12, teacher and staff development and Scholastic Aptitude Test preparation and test reviews.	.A challenge for TI-IN programming is that the states from which schools participate do not have the same curriculum, teacher certification, text books or class schedules; .TI-IN grew from 64 sites to 1,000 districts in 29 states, reaching over 1,000 students; .Successful for-profit operation; .Original target was rural schools which did not have tax base or student numbers to afford advanced, specialized courses. Since then, urban and suburban schools have signed on.	.Satellite to TVRO on school premises; .Audioconference support between "master teacher" and students; .Entering Agreement with ME/U to add cable distribution; .Promise of cable industry to cable every high school in the US will expand service; .ME/U to take on registration and related administrative matters for expanded service.
Supplementing the agricultural curriculum and pooling the expertise of well-known instructors is the objective of the Agricultural Satellite Corporation. Support for extension activities is part of the programming.	.Thirty-three out of 72 land-grant institutions have signed on in the first 18 months; .Some resistance from faculty in integrating programming into their courses; .In first semester 300 students in 13 states participated.	.Satellite to TVRO distribution with audioconferencing; .Plans to link county extension offices into network.
A commercialized multimedia training package for the qualification of	Two multinational companies testify cost-effectiveness of the production partnership and	Multimedia courseware, a 30-module software package, with guided factory tour, phone conversations,

professionals in technical English. The package leads to the qualification of adults in technical English as required for the European Certificate in English for Technical Purposes. It is delivered by the International Certificate Conference (the network of Chambers of Commerce and Industry in Europe); course developed by an industrial consortium with a research centre involved in a DELTA project.	of internal usage of courseware: Renault Véhicules Industriels (savings of 560,000FF/year), Merlin-Gérin Group (saved more than 100,000FF in four months in 1991). Project also shows effective collaboration between research and production.	etc. Open system allows addition of documents or other components. Runs on PC-AT, with audio video card; can integrate distance tutoring with a multimedia messaging system linked to ISDN. Characteristics: individual self-directed interactive work using hypermedia navigation, collaborative group and support, adaptability.

Administrative Support Applications

Learning Issue	Benefits/Outcomes	Technology & Learning Support
Prepare students from feeder schools to prepare for English placement tests to community colleges. [Humber College with a number of schools in Ontario].	.Motivator for high school students by objectively showing them what they have to work toward in order not to end up in remedial English classes; .Gives high school teachers statement on minimum expected English skills; .Issue of external tests; .Currently one out of three students fail the test. Costs for remedial work are around $1 million for one college alone.	.College Board . Computerized Placement Tests for Sentence Skills and Reading were entered into computers in feeder schools; .Students could find out on their own what English language skills were needed.
Course management and academic student support for distance education. The TRIX system links undergraduate students at	.Being tested as a more cost-effective and instructionally effective tutoring model; .Used effectively by the administration as student record-keeping system;	.Computer conferencing and E-mail between tutors, secretaries and co-ordinators, for data entry and report retrieval;

Athabasca University [Canada-wide].	.Used as information source by academic co-ordinators in areas such as enrolment, completion grades, average grades, or to monitor tutoring; .Used by tutors to reference individual student data, to flag students to contact (e.g. those "at-risk" or new students), track their contact with a student, etc.	.Pilot tests of links between students and course co-ordinators for review of assignments, advice, etc.
Computer-managed learning is the backbone administrative system at SAIT and NAIT in Alberta. The system keeps track of progress, performance, course choices, etc.		
The Classroom Management System (CLAMS) offers computer managed learning support to subscribers of BC Tel. The service relieves training departments of the need to operate their own training management system.	.CLAMS successfully supports BC Tel's in-house training for employees across B.C.	.Computer software accessed by telephone; .A similar software package is under development in Europe, as a joint venture of a number of telephone companies, in the DELTA program, phase 1.

Remote access to scholastic tests banks via telecommunication. La société GRICS, Gestion des ressources informatiques du réseau scolaire, Quebec.	Not available.	Administrative software and telecommunications for schools administrators; also BIM (Banque d'instruments de mesure), a bank of tests available for teachers electronically. Numerous products like PIAGET, an individualized management system for schools, TELEMAQUE, an in-house E-mail, DOCIMO, a correction system on microcomputer.
A common computer communication system, tailored to the administrative needs of a number of school boards. La société GRICS is a initiative of the Commissions Scolaires (CS). Main applications are of administrative nature. The CEMIS (Centres d'enrichissement en micro-informatique scolaire) are regional centres that support teacher training in using computers in education. The communication software developed by GRICS is financially supported by the Ministry of Education for the 70 CS that are members via the CEMIS. Usually there is one centre in each CS.	Main uses are information exchange between teachers and database searches. The cost of telecommunications makes it prohibitive for exchange between students at a distance. Also teachers would find it difficult to integrate in curricula, classes and school schedules.	IRIS: Full communication package supported jointly by Ministry of Education and GRICS, using EDUPAC network. Users pay for communication cost.

Vocational & Technical Education

Learning Issue	Benefits/Outcomes	Technologies & Learning Support
Electronics concepts and applications for high school and college students in technical fields for on- and off-campus delivery. Seneca College is integrating a computer-based external course with its own first year curriculum for delivery on- and off-campus.	.Seneca will begin using the course in September 1992. .Approach under review in a study co-ordinated by the International Labour Organization; .The study is looking at issues such as costs and practical implications of courseware that is used internationally. Several European countries are participating.	.Computer-driven multimedia technology; .Mostly used in conjunction with tutors and instructors; .Canadian product.
Mathematics course for self-paced learning for community college-level students. [Seneca College].	Under development.	.A full college course developed around a number of off-the-shelf mathematics computer programs; .Developed for use on-campus, independent learning and on client premises.
Competency-based courses implemented as a state-wide program. [Wisconsin Technical School of the Air].	.Statewide consortium purchased or produced video-based technical courses; .Cost-effective way of acquiring materials through co-operative purchases.	.Delivered by broadcast, cable TV or used in classrooms.
Coping with the special requirements for vocational technical education in distance education. [Minnesota, some initiatives in Oklahoma, Ohio, Wisconsin].	.Instructor training via satellite, teleconferences on CAD/CAM or high technology production; .Busing for hands-on labs, regular classes via two-way TV;	.Two-way TV system with one classroom studio at each school; .Each room has eight TV monitors, three TV cameras, two microphones, one fax; .Connection by cable TV;

	.Reportedly cost-effective and timely method of delivery.	.Networked in a broadcast mode to allow simultaneous transmission of tests, hand-outs.
Certification of Vocational Trade and Industrial Education Teachers by distance education. [Louisiana State University].	.Advantages over on-campus teaching include small classes, no travel costs/time, more personal than correspondence; .Open access to certificate programs to those who would not be able to travel.	.Audioconferencing with graphics support, computers and colour monitors.
Building learning activities on technologies actually used in the workplace. Applying ideas of Freinet's Modern School Movement (MSM) of networking schools and of building learning activities on actual technologies used in workplaces. Tested in a learning network between San Diego (Interactive Technology Laboratory at the University of California-San Diego) and other U.S. sites, Central and South America, and France.	.Was cited as an exemplary project for linguistic minority students by the U.S. Congress Office of Technology Assessment in 1987. .Effectiveness of co-operative learning techniques to reduce prejudice against minority children and to promote positive inter-group relations.	Teleconferencing and electronic mail via network for journalism students and exchange between teachers and "sister classes"; long distance team-teaching partnerships.

ATTACHMENT A 3: Summary of Studies - Videodisc

Name of Study	Content	Experimental Conditions	Compared To	Results
TEC Lessons (1980)	Equipment Use	Level One videodisc (2 versions), slide, sound, no instruction	Each Other	Bessler Cue/See students learned more. All groups achieved more than control
Work of the Heart (1980)	Anatomy	Level One videodisc	Mastery Criteria	All students achieved mastery (70%). Positive attitudes.
Spatial Learning (1981)	Surrogate Travel	Visual data base	Actual Place Learning	Students demonstrated skills similar to actual Place Learning.
USAREUR (1981)	Equipment Use	Level Three videodisc	Mastery Criteria	All students demonstrated mastery (80%). Very positive attitudes.
Biology Course (1981)	Introduction to Biology	Level Two videodisc	Control Group	Videodisc students achieved more (unit 1 = 16%, unit 2 - 3%, unit 3 = 30%, required 47% less time).
HAWK Missile Training System (1982)	Missile Maintenance Skills	Level Two videodisc; videodisc plus practice classroom	Each Other	Videodisc students 100%; practice students 100%; classroom 25%
IVSET Time Telling ogram (1982)	Time Telling (handicapped)	Level Three videodisc	Mastery Criteria	Students mastered (80%) lesson objectives without instructor intervention.
VISTA (1982)	Leadership Skills	Level Three videodisc; role-play group; programmed test	Each Other	Videodisc students achieved significantly more than role play and programmed groups. Students preferred role-play and videodisc version.
Planning for a Better Diet (1983)	Better Nutrition	Level Three videodisc	Mastery Criteria	Videodisc students perceived increased knowledge; no significant gains measured.
Macario (1983)	Spanish Language	Level Three videodisc	Control Group	Videodisc students scored significantly higher than control group on conversational and culture sensitivity test.
Field Radio Repair Course (1983)	Repair	Level Three videodisc	Control Group	Significant differences in group training time; Videodisc students took 25% less time; Cost-effective.
Florida HRS (1983)	Public Welfare	Level Three videodisc	Mastery Criteria, Control Group	Mastery (83%) was achieved in 25% less time by videodisc students; 100% preferred disc.
SIMTAB (1983)	Dairy Cow Artificial Insemination	Level Three videodisc	Control Group (videotape)	Videodisc scores were significantly higher than those of the control group. Both groups posted significant gains. Very positive attitudes about videodisc instruction.

Name of Study	Content	Experimental Conditions	Compared To	Results
Southern Pacific (1983)	Yard Safety	Level Three videodisc	Single Subject Observations	Students reported videodisc to be an effective tool, easy to use, good for remote training. Preferred combination of classroom and disc instruction.
American Bell Inc. (1983)	Sales, Product Knowledge	Level Two videodisc	Survey Results	Students compared videodisc with three alternatives: 80% said it was more effective than videotape or slides; 82% said it was more effective than a text; 76% rated it more effective than classroom instruction.
Battelle ANIGSC-24 Multiplexer (1983)	Equipment Maintenance	Level Three Videodisc	Control Group (actual equipment)	No significant differences in post-test scores, nor on time required. Students favoured actual equipment. Disc was less expensive.
Operating Components of Mechanical Systems (1983)	Using Equipment	Level Three videodisc	Control Group	Videodisc students scored significantly higher on all measures, and completed in less time (10 minutes average). More positive attitudes.
MECC Economics Course (1984)	Introduction to Economics	Level Three videodisc	Mastery Criteria	Videodisc students achieved mastery (significant difference between pre- and post-test scores; 98% rated videodisc very positive).
The Teddy Bears Disc (1984)	Metallurgy	Level Two videodisc	Single Subject Observations	Students very positive about asking provoking questions, feedback, learner control, practice, repeat use.
DEC Studies (1984)	Fault Isolation	Level Three videodisc	Self-Paced Instruction (hands-on)	Videodisc course proved equally as effective; no significant time differences; students found disc more stimulating and motivating.
Paramedical Training (1984)	Intramuscular Injections	Teacher-controlled videodisc; student-controlled disc; classroom	Each Other	No significant differences in group failure rates. Significant time savings in teacher/student controlled disc groups.
Science Laboratory Simulation (1985)	Biology, Chemistry, Physics	Level Three videodisc	Formative Evaluation	Students liked disc self-pacing, personal control, structure, lack of confusion. Completed much more quickly than traditional lab. Faculty anticipated facility and equipment savings.
ANIBQQ Sonar Course (1985)	Equipment Maintenance	Level Three videodisc	Control Group (real equipment	Videodisc students showed reduction in errors; 40% time reduction; improved performance on real equipment.

Name of Study	Content	Experimental Conditions	Compared To	Results
Study Skills for Developmental Reading Students (1985)	Reading	Level Two videodisc	Control Group	Students from both groups exhibited similar attitudes. Videodisc students achieved significantly higher post-test scores and took 50% less time to complete.
Pediatric Neuromotor Assessment (1985)	Assess Infant Motor Dysfunction	Level Three videodisc	Control Group (actual experience)	Videodisc students scored significantly higher on both sub-tests. Rated disc very positive, but preferred actual experience.
IBM Management Training	Management Training	Level Three videodisc: one-on-few, one-on-many, one-on-one; lecture group	Each Other	Videodisc applications (one/few and one-many) resulted in significantly higher pre-/post-test gain scores. Six weeks later, 31% of the one/many, 50% of the one/few, and 11% of the lecture group demonstrated mastery.
Journey man Mechanics (1986)	Using Instruments	Level Three videodisc instructor lead; videotape	Each Other	Students in the videodisc and instructor-led groups performed equally well, both significantly better than the tape group. Disc (as a follow-up to instruction) improved scores significantly and was superior to the other options.
Bank Employee aining (1986)	Sales, Products Knowledge, training	Level Three videodisc	Single Subject Observations	Students rated videodisc instruction as an effective way to learn. Sixty-three percent reported the individualized approach was appropriate to their needs. A generic course that could later be easily customized was successful.
Laboratory Instruction (1986)	Kinetics, Equilibrium	Level Three videodisc - disc only, disc and lab; traditional lab	Each Other	Students from both disc applications scored significantly higher on a post-test than the traditional lab group. Videodisc students scored equal to students who experienced both the interactive program and the lab.
AEP Power Plant Instruction (1987)	Operator Training	Level Three videodisc	Control Group	Students who completed videodisc training and simulation appear to perform better on the comprehensive control room simulator than students who received traditional instruction prior to using the simulator.

ERRATUM

Page 41 of the Technologies and Lifelong Learning report.

The information of the "Summary of Studies - Videodisc" are from the "Summary - Uses and Effectiveness of Videodisc for Training" Videodisc Monitor June 1988

ATTACHMENT B: Barriers to the Use of Technologies in Learning

INTRODUCTION

The **purpose** of Attachment B is to illustrate:

- Barriers which block the widespread use of learning technologies.
- Experiences and reflections concerning the addressing of these barriers.

Attachment B **consists of**:

- Analysis of the case studies and the literature.

The analysis **highlights** that:

- It appears that the barriers to the introduction of technology-based learning are largely related to issues of jurisdiction and of financing methods and procedures.
- In the public education sector these issues are more pronounced than in corporate or private sector training.
- Learners are mostly positive about their experiences with educational technologies.
- Teachers, trainers and others in the business of providing education increasingly support the usefulness of technologies in the learning process.
- Their concerns and suggestions are specific. They include better preparation of professionals to use the technologies and access to sufficient hardware and materials to warrant the transition to new learning and teaching methods.

DISCUSSION

The Learner

Barriers	Addressing the Barriers
Credit is important. Credit for courses taken or learning tasks mastered is important for learners, as opportunities and salaries are often linked to these. However, technology-based learning products do not carry credit or other types of recognition, unless they are used in association with an institution that awards these.	.Prior learning experience will increasingly become a reality in the award of credit; .When it is measured in terms of mastery of a subject matter, e.g. in challenge exams, technology-based learning can be associated with credit; .Quality and content of technology-based learning materials can be judged more easily than lecture-based materials.
Obstacles to studying at home. It is the experience of a number of companies that employees are rarely motivated to study work-related study materials at home.	.Linking in-house training with some form of accreditation may help overcome the barrier.
Access to costly hardware is a problem for learners.	.Some companies are sensitive to this factor and may specify hardware platforms for in-house training materials that are readily available at home.
Other family members may be competing for the same hardware, e.g. computers.	.Occasionally, hardware is made available to a learner for the duration of a course of study.
Interpersonal component is important. Technology-based learning and distance education lack a social component which is very important to learning.	.Contact with mentors, tutors and other learners must be part of the learning process; .These contacts can consist of sessions in person, telephone contact, audioconferences or computer messaging systems;

.Factors such as prior learning experience, distances, or age influence the type of social contact needed.

Human Resources: Staff and Teaching Professionals

Barriers	Addressing the Barriers
Requirements not well known. The many unknowns about costs and the implications of technology make many uneasy about its use. Among the unknowns are staff skills and staffing required to operate and maintain the technology, or to register, mentor and test independent learners. This barrier is present in public education as well as in corporate training.	.Gather more information through studies and observations. .The Association of Community Colleges, for example, is undertaking a Human Resources review, which includes a look at the implications of technologies in the delivery of training and how it relates to staff and faculty at colleges.
Resistance from staff. Many reports cite resistance from teachers and trainers as a key obstacle to the effective use of technologies in education and training.	.This barrier will remove itself with increased experience and exposure of teachers. In a U.S. survey of 1,100 precollegiate teachers, they agreed that the use of computers in the classroom is a positive development in the learning process (see Appendix at the end of this section for details).
Limited knowledge of technologies. Teachers, trainers and training consultants typically have not received the training, nor do they have the hands-on experience, to be comfortable with the use of technologies in teaching.	.Teacher training in the use of technologies in the learning process appears to be a key to their successful use. Teachers who participated in the above survey agreed that even those teachers who are using computers in the classroom are not adequately trained for their use; .Concordia, Laval and Montréal are the only universities in Canada that offer

	graduate degrees in educational technology. The programs should be expanded to be offered at all institutions that produce future teachers and trainers.
Lack of sufficient hardware. Lack of sufficient computers or technology-hardware units makes it difficult for teachers, trainers and consultants to integrate technologies into the teaching-learning process.	.Several U.S. states have legislated access to technologies. For example, in Kentucky every classroom will have to have a telephone connection. Every school in the state must furthermore have a TV satellite reception station; .Major players in the U.S. cable industry have committed themselves to cabling all classrooms in their franchises; .Michigan has awarded $18 million in computer equipment to 8,000 teachers in the "Classrooms of Tomorrow" project. The awards were based on proposals from teachers. .In the private sector, computers are pervasive in many jobs. They are typically fully used for operations and access for training is not often convenient or encouraged.
Bad previous experiences. Early experience with poor courses and hard-to-use technologies has discouraged many teachers and trainers.	.New generations of hardware and better courseware will slowly help overcome the early mistakes; .Quality and educational and pedagogical value of materials will obviously be a continuing concern of the profession. Some efforts to implement quality checks of commercial materials have been implemented; e.g. in Ontario, Minnesota or Germany.

Facilities

Barriers	Addressing the Barriers
Facilities are not wired for communications. To use technologies to maximum benefit, existing learning centres or other facilities need to be altered to feature new wiring, telecommunications ports, as well as security during longer opening hours, etc.	.In test or model schools or in learning centres, private companies with an interest in information technologies will invest in the infrastructure at a school, most likely in conjunction with the school board; .For large-scale operational use of technologies, funds will have to be found elsewhere.
Existing facilities may be obsolete. A significant increase in the use of technologies for learning may make much of today's investment in facilities obsolete, either because they are not suitable for the purpose or they become redundant.	.Rationalize investments in new technologies for learning on the basis of needs of the larger community.
Not enough experience to define requirements at "learning centres". Corporate training departments, colleges and private suppliers expect that some form of "learning centre" will be part of the future delivery system of education. Experience still lacks to define appropriate facilities, staffing and operation of technology-based "learning centres".	.More nuts and bolts information needs to be collected and researched to help the development of "learning centres"; .Issues to be explored include configuration of rooms, modes and times of access to facilities, numbers and types of hardware units per learner, and different forms of tutoring and mentoring; .Learning centres that are commercially operated may be viable where they can attract sufficiently large numbers of corporate and other users to be able to offer bulk discounts.

Structural Issues

Barriers	Addressing the Barriers
Learners who choose courses from a range of sources lack adequate support for mentoring and credits. Lifelong learning that is supported by technology can truly empower the learner. Theoretically, the learner has many choices among courses offered by a number of institutions or using a computer-based course over a series of videoconferences. The learner will, however, encounter difficulties when he wants credit for the work done, or when he needs counselling support. Co-operation among educational institutions will be essential for the learner.	.The fact that empowered learners will chose what they want to learn, when and where, should be recognized in the system of awarding credits. The experiences of the Open Learning Agency in B.C. and the National Technological University (U.S.) are models to explore. .In addition to credits the empowered learner will need mentoring and support, which is not likely to be available from one institutional advisor as in the present system. Perhaps community-based advisors will be available in the future to assist learners in making choices. Software such as the learning "credit card" can assist learner and advisor in this process.
Limited institutional experience in effectively managing the learning-teaching process. To make effective use of technology-based learning, most observers agree that the structure of the teaching-learning process must change. There are as yet no clear directions, however, for such change.	.Curriculum development that integrates technologies as teaching tools have been instituted in some European countries, notably Spain, with apparent success; .Other measures which appear to be essential to effective uses of technologies in learning include open entry and open exit systems that support more or less continuous use of the hardware; self-paced and individualized learning which supports the previous point; and a system that measures outputs (i.e. what the learner accomplishes) instead of inputs (i.e. time spent on a task).
Supporting training will be part of line managers' responsibilities. Effective use of technologies in in-house training makes decentralized training cost-	.Supervisors and managers need training programs on how to train. A number of courses are under development by different entities, some technology-based;

effective. It shifts some responsibilities for training from the training department to the line departments and to the place of work (e.g. in Performance Support Systems). Supervisors' jobs typically do not include formal training.

.Job functions in line departments need to be linked to training so that mentoring and follow-up does occur.

Short, on-site training modules are preferred by firms, but rarely available.
Adult learners and employers appear to prefer learning that can be taken in shorter modules over full-length courses. A switch by a college to a modular system requires changes in staffing, procedures and facilities operation.

.Technology-based modules can easily be organized in shorter modules;
.Computer-management of the learning system greatly facilitates the more complex administration of a modular approach.

Financing

Barriers

Purchasing practices are unfavourable to technology-based methods.
Two factors that govern much of the budgeting and purchasing of training in corporations as well as in government procurement, discriminate against technology-based learning tools. One is the tendency to purchase input, i.e. time spent. Technology-based learning shows that equivalent learning results can be achieved in shorter periods of time, at lower costs over time. The second factor is that the front-end costs for technology-based training are higher than for traditional approaches. Therefore, the two approaches require different patterns of expenditure over time.

Addressing the Barriers

.Economic studies should be carried out of real programs and purchases to model benefits and shortcomings of technology-based learning;
.In the corporate environment, budgeting procedures are beginning to reflect the requirements of the new delivery system.

Funds available on a per student basis for learning tools are too limited to support use of quality materials.
In the public school system (U.S.) only about $100 to $200 dollars per year is allocated per student for learning tools and materials.

.More funds need to be allocated to teaching materials to make available sufficient resources for technology-based learning;
.Some studies suggest that from 5% to 10% of school and college budgets be reallocated from payroll and administrative overheads to technological innovations;
.Another suggestion is that, given findings that teachers' roles change and that they can support more learners in a technology environment, a totally new approach be tried. One learner roughly equals $5,000 in annual expenditure per classroom in the US public system (and $6,150 in Ontario's Community Colleges). Should a teacher take on five more students, this would equal $25,000 annually more per classroom. If 77,000 teachers were given $13,000 of this amount to spend on technology-related materials, there would be a market of $1 billion per year. Such figures will make learning a serious market for technologies.

Significant infusion of funds will be necessary to equip the learning system with sufficient hardware for effective technology-based learning. Large-scale operationalization of technology-based learning will require large investments in hardware. A course that uses technology as the main method of instruction typically can accommodate between four to six learners in different shifts during the day. On a national scale, initial investment costs could be staggering. To illustrate: the two million additional learners which we may have in Canada annually, may require around 500,000 units of hardware. Assuming the costs for a unit to be around $2,000, the initial investment required will be $1 billion for the hardware alone. To

.The reallocation of education budgets is one method of obtaining some of the requisite funds. In Canada this may yield $4.5 billion annually, using 10% of expenditures (1991);
.In the U.S., commercial ventures are beginning to target this market and bring private moneys to the task of paying for the infrastructure. Profits from these ventures will accrue over time through fees for operating the infrastructure. Public education as well as commercial training departments are buying into such services.

this must be added costs for facilities, mentoring services, telecommunications charges and courseware costs.

Quality learning materials need to be supported with deliberate procurement decisions.

Large-scale operationalization of a technology-based learning system will also require large investments in software and courseware. In particular, large initial investments will be required to produce quality materials.

.The economics of courseware are different from those of hardware. Large numbers of learners who use a given unit can make its costs almost negligible;

.A number of commercial interests in the U.S., such as Turner Broadcasting Systems, have established units for multimedia educational productions. They can raise sufficient funds to produce high-quality generic materials for the growing education market;

.Canadian courseware producers have excellent products, but are small companies. They need access to sufficient funds to support high-quality products. Among the vehicles under discussion are venture capital, a rotating development fund and deliberate government procurement policies;

.Learning materials that are "third generation" rely heavily on real-time access to "domain"-specific materials as well as on interactivity with peers and tutors. Experience with these materials is only in its infancy and it is difficult to project their cost implications.

Barriers	Addressing the Barriers
Many technology-based materials are "one-of-a-kind" and do not link to a curriculum, e.g. as a text book would. The link between materials available and the school curriculum or materials and the progressive learning needs of an employed worker is not well developed. Teachers, trainers or learners have to be able to identify not only their learning needs, but also appropriate products and their connection to or overlap with a unit accomplished earlier.	.Provincial education curricula give direction for materials development. However, their differences make for a number of small markets. Pathfinder Learning Systems is unique in that its approach is based on generic curriculum guidelines of all provinces. Teacher training and support is required to help teachers pull out the tools relevant for their school; .Several recently created councils, in sectors such as automotive repair, are establishing sector-wide learning goals and standards. This will likely encourage the development of related materials, as it gives producers the framework of learning needs and an approximation of the size of the market; .It has been suggested that producers themselves form a council to develop a more "user-friendly" approach for their customers, by providing an overall "road map" through their products.
Teachers/trainers do not like using materials developed by someone else. Resistance against technology-based materials often stems from the reluctance of educators and trainers to use materials developed by someone else.	.Generic materials are increasingly accepted, as software products now allow educators to adjust and tailor them to their own needs; .To make such adjustments, however, teachers and trainers need to be trained in the use of the technologies.

Technology

Barriers	Addressing the Barriers
Uncertainty about the need for and rates and access to high-capacity networks. The present telecommunications infrastructure does not have the speed or capacity to handle evolving multimedia applications for learning.	.Full-service ISDN will be available via the public switched network to business in major centres by 1996. This service will replace separate communication systems for voice and data and will bring a range of new services; .Broadband ISDN could be available within ten years, depending on market demand; .Some companies find it too costly to distribute CBT materials with high graphic content via telecommunications. They will distribute these materials by mail, but link remote learners into a data network which supports the administration of learning.
Resale as a regulatory issue. Use or "resale" of private network capacity outside educational institutions raises regulatory issues. This is an issue, for example, in an education and research network that has been created in Nova Scotia between universities and companies.	.Increasing use of computer communications for learning between learning centres, learners at home, etc. will require a review of rules related to resale and access re: private networks.
Non-portable software. On the software side, a number of barriers to expansion are prominent. They include software that is non-portable and a closed system. Software that uses different platforms and operates under different standards and protocols and cumbersome person-machine interfaces.	.Software engineering is progressing with new tools and techniques; .Companies and institutions that have know-how in education need to participate actively in the integration of digital technologies into existing infrastructures.

Jurisdiction

Barriers	Addressing the Barriers
Lack of public policies and leadership in the face of rapidly expanding choices for learners. Governments will lose control over how many people get trained in each field, as learners can access many different subject areas from very different sources. When linking these choices to the acceptance of "prior learning experience", it is evident that new forces will shape the future of educational supply. It is not evident that public policies have been shaped to give leadership to such developments.	.Undertake a review of possible scenarios.
Geographic boundaries become obsolete with learning technologies. Educational technologies and distance education make geographic boundaries obsolete. The best subject experts, pedagogues and technologists from anywhere can be teamed to develop up-to-date, high-value materials for use by learners anywhere. Present funding and jurisdictional structures do not encourage such development in the public sector, where, for example, courses and programs are duplicated across a province, competing with each other for learners and resources.	.Commercial and corporate ventures, such as the National Technological University, show that such services can work successfully; .Procurement and financing rules of governments can encourage the status quo or can encourage innovative ways of overcoming jurisdictional barriers; .For example, governments could ask for bids to bring state-of-the-art learning of basic electronics to all part-time and full-time learners in technology programs. The bids would specify the level of mastery to be achieved; .The bids could be directed to the same players in the public system who now provide the service. This would, however, spawn innovation and lead to new partnerships betweer. public education institutions.

Duplication of services and facilities.
Different levels of the education system offer similar learning services, as a result of factors such as location or precedence. Technology-based learning is cost-effective when facilities at the community level are rationalized.

.At the local level, the same hardware and facilities should be open to learners from different levels of the formal system as well as for in-house training and for general enrichment learning;
.Such co-operation is necessary, because training hardware needs to be used extensively to make the investment cost-effective;
.However, such co-operation does imply that partners lose some control over facilities, purchases and procedures, e.g. opening hours;
.Different solutions have been found in the form of commercially operated learning centres, community facilities and libraries;
.Mentoring and tutoring, which are important components of learning, are often supported remotely by phone, fax, E-mail.

Implementation

Barriers

Technology-based learning needs national champions.
Political and senior-level leadership is essential to creating the will to fully integrate technology into the learning system. This leadership must come from the educational community and must avoid favouring any one technology.

Addressing the Barriers

.The crisis in education and training and the associated change in paradigm to a national learning culture is creating fertile ground for such leadership;
.Technology-based learning is becoming less threatening as more experience is gained.

Barriers

Dangers of waiting for long-term research.
Reliance on convincing, large-scale evaluation results will compel the public schools to wait forever before adjusting their structures and to use technologies effectively. First, such studies must be longitudinal. Second, funds from "sources without interest" are not available.

Addressing the Barriers

.Influential and well respected champions can leverage the research available to date;
.In the U.S., some of these champions are business people and politicians who find sufficient validity in the research available to use it as the basis for major financial commitments.

Computer Report Card

From the back office to the home office to the factory floor, the use of technology in business has followed a fairly consistent pattern: initial resistance followed by rave reviews. In education, unencumbered by competitive pressures, the process has taken longer but the results appear to be similar: Teachers, after years of resistance, increasingly see technology as an important element in school reform.

In a July 1989 nationwide survey of precollegiate teachers, conducted by the Wirthlin Group for IBM, teachers agreed that the use of computers in the classroom is a positive development in the learning process.

The study, entitled "The Computer Report Card: How Teachers Grade Computers in the Classroom," reported the results of 1,100 telephone interviews; among its many findings are the following:

Drop-out Rates

■ A majority of the teachers surveyed (64%) indicated that computer use helped reduce the drop-out rate by stimulating at-risk students.

Literacy

■ Most teachers (82%) found that the use of computer-based reading and writing programs in the early grades helped reduce the illiteracy rate.

■ An overwhelming 91% of all teachers polled said that computers were effective tools to help students develop basic reading and writing skills. And 60% thought that computers were not used frequently enough for that purpose.

Student Motivation and Skill Development

■ Four out of five teachers who used computers for instruction (82%) said computer use had increased their students' motivation to learn.

■ According to 86% of those surveyed, computer use aided student problem-solving ability.

■ Even more teachers (87%) found that computer use boosted students' self-confidence.

■ And 86% thought that computers helped them unlock the creative potential of students.

College Preparedness

■ Three out of four teachers polled (74%) asserted that computer-illiterate students were not adequately prepared for college.

Equity of Access

■ Nine out of 10 (90%) found lack of computer access to be a special learning disadvantage for students from less-affluent schools.

Curriculum and Instruction

■ When asked in which subject areas computer use was most effective, the teachers' most frequent response was math (49%), followed by reading, writing, or language arts (24%). More than one-third of the teachers (37%) volunteered that computers could be used most effectively in "all subjects."

■ Overall, three out of four teachers (75%) said that computers allowed them to spend more one-on-one time with students.

■ Nearly three-quarters (74%) found that computer use in the classroom allowed them to be more creative in their instruction.

Discipline, Attendance Problems

■ Three out of five teachers (62%) agreed that computers could help reduce classroom disciplinary problems.

■ More than half (56%) agreed that computers could help reduce absenteeism by making classroom study more interesting.

Alcohol and Drug Abuse

■ Most teachers (70%) agreed that software incorporating the high-tech culture of today's students, such as interactive video and audio systems, could make it easier to reach students with important social messages about alcohol, drugs, and sexuality.

Parental Involvement

■ According to 63% of the teacher sample, computers used in the classroom could stimulate greater parental involvement.

Impact of Computers on Education

■ Overall, 85% of teachers interviewed thought computers used in the classroom had a positive impact on the quality of American education.

■ Many teachers (68%) cited lack of resources (money, computers, software, or space) as one of the greatest obstacles to more effective use of computers. More than one-third (38%) identified inadequate training or lack of computer experience as a primary obstacle.

■ Three out of four teachers (72%) in computer-using school districts indicated that computers were used effectively for instruction. However, only 59% of teachers thought computers were used effectively in American education generally, while 31% believed computers were not used effectively.

■ Only one in 10 teachers thought that computers were a fad and that they distracted educators from "the basics."

Computers, Teacher Training, and the Teaching Profession

■ Computer skills will become increasingly important in terms of gaining employment in education, according to 72% of the teachers.

■ More than half (59%) agreed that "most teachers who are using computers for instruction are inadequately trained for their use."

■ Half the teachers (52%) thought their students were more computer literate than they were.

■ Finally, more than half (61%) of all teachers surveyed think that more widespread use of computers in education can attract others to the teaching profession.

— J.J.H.

ATTACHMENT C: Technology: Research, Development and Innovation A Glimpse at Activities in Industrialized Countries

INTRODUCTION

The **purpose of** Attachment C is to:

- Offer a glimpse of the magnitude and diversity of research and development and of innovation in learning technologies.
- Illustrate Canadian activities.
- Illustrate the importance that organizations in industrialized countries award to the emergence of learning technologies.

Attachment C **consists of**:

- A sampling of leading institutions in Canada and in the European Commission, as well as of key research and development activities under way that relate to the use of advanced technologies in learning. The list is meant to be indicative only, not exhaustive.

Attachment C **highlights** that:

- Significant R&D funds are spent by the European Community to define and develop the use of advanced technologies for learning.
- A fair bit of research and innovation is happening in the U.S. (not fully represented in this text). A major strength of developments in the U.S. is the entrepreneurial orientation of these developments, leading to the early application of innovations.
- Canadian institutions and companies are also engaged in related research, but have relatively limited funds at their disposal. Reportedly, Canadian private sector companies and public institutions are much less willing to test and introduce innovations than are those in the U.S.

- Increased partnerships in research with other countries and the promotion of entrepreneurial opportunities will be essential for Canada in the long term.

DISCUSSION

In order to understand the role of technologies in Lifelong Learning (LLL) development, one must consider the context of the integration of these technologies; there is a paradigm change in education where these technologies play a role. After a long behaviorist period, and after a cybernetic view of individualized teaching via technologies, a constructivist conception of learning is becoming the rule, with cognitive technologies as supportive environments. After Piaget saying "every time you teach children something, you prevent them from learning it themselves", we rediscover that in order for a learning process to happen, learners have to construct knowledge based on their own cognitive structures and on their previous knowledge. Implications for LLL are crucial, if one considers that the key for successful LLL is a lifelong "readiness to learn" in which we understand that the learner knows how to learn.

Interactivity--not only with a domain, but also with other learners, i.e. with peers--is a key concept in this view of learning. This is where advanced technologies come into action, allowing an open range of interactions with a subject matter or domain and interactions between learners at a distance. A merging of distance learning technologies with other technologies is expected where distance not only means geographical distance but distributed systems and asynchronous learning.

The main developments in R&D that affect LLL applications are software engineering, knowledge-based systems, multimedia (CD-I, DVI, HDTV) and hypermedia and ISDN transmission systems. The following are some of the main issues where technological developments will have an impact on LLL deployment; also listed are some major initiatives in this direction.

Software evolution and reuse:

Educational applications suffer from non-evolutive software. With the implementation of software engineering principles and techniques (reverse engineering, re-engineering, etc.), one expects significant improvement in terms of reusability, expandability and portability of software. Higher-level tools, better development methodology, integration of users in the development cycle, elaboration of software life cycle (including maintenance): all this should bring better quality, adaptability, adequation, and finally user acceptance. It should also promote long-term investment in educational software.

Platforms:

"La guerre des plate-formes fait rage et nuit au bon développement des applications en éducation." Platforms are different in education than in industry (manufacturers consider educational and home markets the same); in the world of training, they belong to either one. With the "platform war" also raging in the industrial world (and very fast-changing alliances between manufacturers), this aspect becomes a nuisance in the development of educational and training software. Despite expressed needs for common or compatible platforms, three platforms are expected to stay in the educational market until the year 2000: Windows, Unix, and the MacIntosh.

With LLL, the educational software market will be more integrated with the home market on the one hand, e.g. interactive video and television systems, etc. The integration of training and support systems into industrial systems, on the other hand, will mean unification of platforms (also probably upgrading of training platforms). Merging of computer, film and television will happen with HDTV, already on its way with CD-I and DVI (more with virtual reality).

Advanced interfaces:

Unproductive and badly accepted software is partly due to ineffective or inadequate interface. Advanced techniques like icons, video images, direct manipulation, graphics, handwriting recognition, speech and sound will solve major parts of the person-machine interface problem. Advanced interface development software, like Hypercard, facilitates interface design and editing as well as integration of various types of software in a very simple and flexible way. Hypermedia interfaces bring the versatility and flexibility that is needed for educational applications; therefore, their role is a major one in promoting and expanding advanced technology in education.

Performance support systems:

These are systems that integrate training and work in the same environment, where learning support tools are available on a continuum from initial learning to reminders or knowledge updates. This is not always possible, particularly in critical and hazardous environments where simulators or simulations are a better solution. They are excellent systems to bring about a better transition from the educational milieu to the workplace, as they promote the use of the same platforms and tools and as they integrate applications in work and educational environments.

DELTA, EC Program

Goal	Activities	Outcomes
To put together efforts and resources to promote the use of advanced technologies for education and training.	Joint research between universities and industry, and between European countries. DELTA 92 is the second 5-year program, aimed at applying and testing results of the first phase. DELTA 92 has 22 projects, such as JITOL (Just In Time Open Learning), SMISLE (Multimedia Integrated Simulation Learning Environment), MTS (Multimedia Teleschool for European Personnel Development) [DEL92].	The outcomes of the first phase are prototypes as well as experience in collaborating, increased familiarity among project partners, and the dissemination of information. Prototypes: ORGUE/SHIVA, a knowledge-based authoring environment (Project AAT, Advanced Authoring Systems); LIVENET, a videoconferencing system on the London University campus, etc.

COMETT, EC Program

Goal	Activities	Outcomes
Co-operation between universities and industry regarding initial and continuing training in the field of advanced technology (200M Ecus for COMETT II, 1990-1995).	Four elements: A) Reinforcement of university-enterprise training partnerships; B) Transnational exchanges for students; C) Joint projects for continuing training in advanced technology and	COMETT I: 125 university-enterprise consortia; 400 students exchanged; 232 bursaries for personnel exchange between universities and industries; 329 joint projects of continuing training and of

	for multimedia distance education; D) Promotion of complementary activities.	multimedia systems development.

TELEPRESENCE
Ontario - Europe Consortium

Goal	Activities	Outcomes
Joint three-year government, university and industry R&D project set up to accelerate development of Ontario's capabilities and opportunities in the marketplace emerging from the convergence of telecommunications, computer and audio-visual technologies. The project is under the auspices of two Ontario Centres of Excellence, ITRC and TRIO, in collaboration with European provinces known as the "Four Motors of Europe." Half of the funding ($2.6 million) is through the Technology Fund of Ontario, and the other half through the consortium; the federal Department of Communications contributes Olympus satellite time.	Development of a platform to support collaborative work with video-conferencing and other advanced technologies. Oriented toward broadband communications, Telepresence involves multimedia real-time groupware, multimedia database systems, multi-user interfaces, image processing, local and wide area networks. Human factors research will concentrate on support of multi-party video conferencing, support of collaborative writing, user interface issues for multimedia documents, active and hidden technology, role of video and impact of video quality, social behaviour in Telepresence systems. The Ontario consortium develops the technology; European partners contribute applications in telemedicine and learning.	Expected in 1995.

LLAMA
IBM Consortium on Foreign Language Learning

Goal	Activities	Outcomes
Joint development of and experimentation with multimedia software; 7 university members, 10 affiliate schools in U.S.	. Brigham Young U: German pronunciation, language and culture (still and motion video images, graphics); Spanish Interactive Video; . Smith College: Digital Interactive Audio System (Motion digital slide and digital audio functions integrated in listen and repeat program); . U of Calgary: VICONTE, interactive videodisk to teach French as a second language; - U of Chicago: "Sur la bonne voix: approche communicative de la litérature; multimedia interactive environment to explore literature"; - U of Urbana: Fête française, videodisc; German Newsroom, with videotapes from Goethe Institute; . U of Iowa: Trilingual videodisc. Selections from French, German, and Spanish; . U of Pennsylvania: Cinema, using 24 films to create multimedia annotated versions of feature films.	Not available.

ARC
Alberta Research Council
Learning and Collaboration Group
Calgary

Goal	Activities	Outcomes
Joint R-D projects with industries, in the field of intelligent interactive learning environments, computer-managed instruction, collaborative learning systems.	Joint projects with companies, governments: . STUDY (authoring and delivery of interactive materials); . LMX (Learning Management Expert); . participation in Precarn's IGI project (Intelligent Graphic Interface).	. Commercialized knowledge-based instructional systems, prototypes like STUDY, products like LMX; . Knowledge transfer to industry and government and networking with industry (Information Hut project).

CRIM
Training Technologies Project
Montréal

Goals	Activities	Outcomes
Joint R&D on technologies and training between universities and industries.	A six-month start-up phase in 91-92, to lead to a five-year project on performance support systems and help systems.	Infrastructure of a "vitrine technologique", a technological showcase.

CWARC
Performance Support Systems Group
Laval

Goal	Activities	Outcomes
Joint R&D projects with federal departments, universities and companies.	A three-year program (1992-95) in the area of performance support systems and help systems.	TRANSFORM, a project for developing a cognitive task analysis tool to support instructional design by instructors in government, with Softwords and Training and Development Canada; LOIFF, a multimedia prototype for training immigration agents, with Micro-Intel; Formedia, a database on resources in instructional design; dissemination of information.

PIME
Programme d'intégration
de la micro-informatique dans l'enseignement
Ministère de l'éducation du Québec

Goal	Activities	Outcomes
Training teachers in integrating microcomputers with pedagogy.	Four-day sessions in the regional CEMIS (Centre d'enrichissement de la micro-informatique en milieu scolaire) to give a pedagogical framework for using computers.	Very successful; teachers find the pedagogical approach useful. The program reaches hundreds of teachers in the regions.

ATTACHMENT D: Examples from Across Canada: Some Key Projects and Established Players

INTRODUCTION

The **purpose** of Attachment D is to:

- Highlight some of the key Canadian players who use different communication technologies to provide components of lifelong learning[1]. They also are likely to consider themselves allies of a lifelong learning system.

- Provide a sense of the infrastructure and services that exist in different parts of the country, primarily in the public sector.

Attachment D **consists of**:

- A coast-to-coast listing of institutions and projects, drawn mostly from personal knowledge.

Attachment D **highlights** that:

- A number of organizations use technologies to support learning.

- In most cases, broadcasting, satellite videoconferences and audioconferences are used.

- Several provinces support or have supported the development of learning materials for the school system.

[1] It is impossible in this project to include all players and activities. A national survey in 1988 by Stahmer listed more than 70 active projects using technologies and learning across the country.

DESCRIPTION OF EXISTING INFRASTRUCTURE

Main focus/Region of Operation	Type
Open Learning Agency (including Knowledge Network) (British Columbia) college and university courses; open admissions; public broadcasting; provides expertise and facilities to educational providers; research in new technologies.	Broadcast TV via satellite and cable; audioconferencing; new technologies (e.g., ISDN and computer based).
North Island College (British Columbia) Delivers individualized open learning through learning centres and tutors.	Interactive broadcast; on-line conferencing.
Athabasca University (Alberta) Provides university courses at a distance; co-ordinates and works with colleges and universities; open admissions; research in new technologies.	Audioconferencing; CML; new technologies (especially computer-based).
Access Network (Alberta) Public broadcasting; provide programming for K-12, adult and post-secondary in co-operation with educational providers.	Broadcast via cable and off-air transmitters; radio service; new technologies, e.g. VSAT, etc.
Saskatchewan Communications Network Two networks: SCN Training Network for live interactive credit programs and Cable Network for educational TV from university; operates transmission and receive site network; co-ordination.	Satellite delivery through channel multiplexing.
Manitoba Satellite Network Operates transmission and receive sites throughout Manitoba; delivers secondary and post-secondary courses as well as public sector training.	Satellite delivery; microwave link and fibre optic link.
TV Ontario Public Educational Broadcasting; in-school support; teacher professional development; some university credit; Skills Channel for "niche" training.	Broadcast TV; network of teachers; research in new technologies.

Open College/CJRT-FM (Ontario) Credit courses at university level.	Radio broadcast; cablecasting; audioconferencing.
Contact North (Northern Ontario) Communications highway allowing educational institutions to deliver courses; provides training and support to providers.	Audioconferencing; audiographic systems; computers; fax; audio and video.
Télé-Université (Québec) Provides university courses at a distance; works with other delivery agencies; research in new technologies.	Broadcast TV; inter-campus network supported by two servers: INFOPUQ and UNITL; connections with students via EDUPAC and DATAPAC; fibre optic link between Montreal and Québec.
RISQ Réseau inter-universités scientifique québécois, CRIM, (Québec). Access to software; information exchange; file transfer; support for team work; news from USEnet.	Connects universities and research centre together and with other international research and academic networks. Funded by CRIM; fees for members; operation services a donation by McGill University.
CANAL (Montréal) University consortium for distances education on TV; 8,000 students per year obtain credits through respective institutions. Fields: sciences, languages, management, computing, education, literature, arts, health, etc.	CANAL (Corporation pour l'Avancement de Nouvelles Applications des Languages) is a non-profit organization, a consortium of universities and other institutions sharing broadcast time on TV for distance education; also an agreement with TV Ontario for time exchange.
New Brunswick In planning stage; a multipurpose and multi-stakeholder distance education and training network.	Range of technologies to be finalized in a network of learning centres.
Nova Scotia Nova Scotia Technology Network links, at moderate speed, academic institutions and some private companies. The goal was to stimulate the development of R&D in technology in the province. After initial government funding the network is expected to be self-financing within 3 years.	Computer communications on facilities that are leased from the carrier. The network itself is configured, built and managed by an entity created for the purpose. It was to be part of the CANARY initiative. One regulatory issue that it is encountering is the issue of resale, since private firms are part of the network.

Across Canada
(Other)

K-12 Sector & Adult Secondary Completion Providing courses to students and adults leading to high school completion; particularly strong in Alberta, B.C. and Northern Ontario.	Audioconferencing; audiographics; computer conferencing; CML; new technologies.
Post-secondary Sector Colleges and universities across Canada offer off-campus programming as well as technology-based on-campus classes. Key players include Memorial, Mount St. Vincent, Waterloo, Ottawa, Laurentian, Lakehead, Manitoba Interuniversities North, Simon Fraser, University of Victoria, Sheridan College, Cambrian College, College L'Acadie, etc.	Audioconferencing; audiographics; compressed video; live interactive via satellite TVRO sites; computer conferencing; CML; new multimedia technologies, etc.
Professional Development Professional upgrading programs delivered by specialized agencies, universities and colleges to nurses, engineers, doctors to nurses, engineers, doctors, lawyers, etc. Agencies that use such service are numerous (i.e. hundred's) and include: National Technical University (US), Telemedicine Canada, the Michener Institute. A number of universities and colleges operate satellite conference facilities which can be booked for a fee.	Satellite delivery; audioconferencing; computer conferencing.
Private Sector Providers Delivery Service through electronic highways; key players are Telesat Canada and the telephone companies across Canada, Canadian Satellite Learning Systems; across Canada; EDS Canada, Ltd; Canadian Teleconferencing Network (owned by CANCOM). An increasing number of companies have their own private satellite network.	Satellite delivery; fibre optics; compressed video; multimedia technologies; audioconferencing.

ATTACHMENT E: Learning Technologies: Definition and Some Characteristics

INTRODUCTION

The **purpose of** this Attachment is to demonstrate the range of technologies that are used effectively for learning.

Attachment E **consists of** excerpts from research reports, namely:

- *Suppliers of Technologies for Workplace Training*. Stahmer, A., for ISTC Sector Campaign to Strengthen Commercial Suppliers of Education and Training (1992).

- *Worker Training*. US Congress, Office of Technology Assessment (1990).

DESCRIPTION

EXCERPTS FROM *SUPPLIERS OF TECHNOLOGIES FOR WORKPLACE TRAINING*[2]

Training Technologies: Definition

Training technologies should be defined very broadly and include any technologies which are used to develop or to deliver or to support (e.g. administer) training. Computer-based technologies, or CBT, include a wide subgroup of TBT, such as CD-ROM, videodiscs and simulators. It also includes the software required to develop learning applications, to guide instructional design. It also includes the setting in which learning takes place, e.g. the home, classroom or work station.

Technologies Used for Training

The following lists show the wide range of training technologies and their applications. The Office of Technology Assessment of the US Congress identified the following technologies[3] as currently use or under development for workplace training:

- Combined lecture/laboratory.
- Print.
- Audiotape.
- Videotape.
- Television.
- Computers.
- CD-ROM (Compact Disc/Read-Only Memory).
- Videodisc.
- Compact Discs Interactive.
- Teleconferencing (video, audio, computer).
- Simulators.
- Installed infrastructures (e.g. Local Area Networks), which facilitate performance support.
- Digital videodiscs.
- Electronic classrooms.
- Digital networks.
- Virtual environments.

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[2] Stahmer, A. for ISTC, 1992.

[3] Excerpted from *Worker Training*, Office of Technology Assessment (1990), United States Congress, Washington DC.

Technologies are changing rapidly. Computer storage capacities are growing, expert and authoring systems are changing the world of software, and previously separate media are being integrated into multimedia systems. Multimedia systems will give trainers powerful tools, as research has shown that the wider the range of media used, the greater the proportion of students who succeed in learning effectively[4]. With multimedia technologies, designers easily integrate a range of media into an instructional package. Further, reasonable prices and wide availability will make them also attractive to trainers, once they become consumer products.

Increasingly sophisticated technologies are becoming part of the operational infrastructure of companies and are said to encourage the fusion of training and every day work routines. Support for this trend can be found in the fact that industries with higher existing investment in technology infrastructures use computer-assisted education more extensively than others[5]. Other reports suggest, however, that companies rarely use the same computer terminals for operations and for training[6]. Among the reasons are that the terminals are typically heavily used for operations and that access for training purposes is not "user-friendly".

Changes in technologies are also expected to change the distribution and delivery of training materials. Today, the majority of training materials is distributed physically by videotape or computer disc. High-capacity communication networks are expected to carry training materials on demand directly to the learner, as and where needed[7]. Such developments could have significant implications on the costing rationale of TBT.

At present, however, the predominant technologies used to support workplace training are print (workbooks) and video materials.

Features of Effective Training Technologies

Experiences of the past two decades show that, given reasonably favourable circumstances, a person will learn from any medium[8]. The way in which a given

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[4] Smith, Ralph. "The Scope and Growth of Distance Education", Regional Seminar on Distance Education, Asian Development Bank, Bangkok, 1986.

[5] *Technologies in Services*, a study by ISTC and DOC (1990), p. 25.

[6] Stahmer and Green, case studies from Ontario companies, for Ontario Training Corporation (1992).

[7] Under the EC program Developing European Learning Through Technology Advances (DELTA), several European telephone company have joined in a research project to develop such service. BCTel is offering a related classroom management service (CLAMS).

[8] Ruggles (et al.) *Learning at the Distance and The New Technologies*, Educational Research Institute of British Columbia, Vancouver (1982).

technology is used, and the way it is combined with other learning methods is often more important for its effectiveness than the technology itself. Effective technology-based training needs to include the following features:

- Provide suitable interaction between learner and materials.
- Be relevant to what the learner needs to know.
- Allow the learner to enter the learning process from the basis of his/her knowledge of the materials, not from a fixed, pre-determined entry point.
- Permit the learner to pace the learning process, including repetitions.
- Be capable of handling management details which ease the administrative load of trainers and supervisors, including record keeping, reporting on learner progress or recommending remedial learning.

These features are not necessarily dependent on one technology or another. However, generally, computer-based technologies have significant advantages in that they can incorporate more interactive and administrative features into the design than any of the other technologies. Multimedia systems which combine computer-based features with voice, video, graphics and simulations may have significant advantages over others. Costs associated with these technologies will make them more suitable in learning centres than for learning at home.