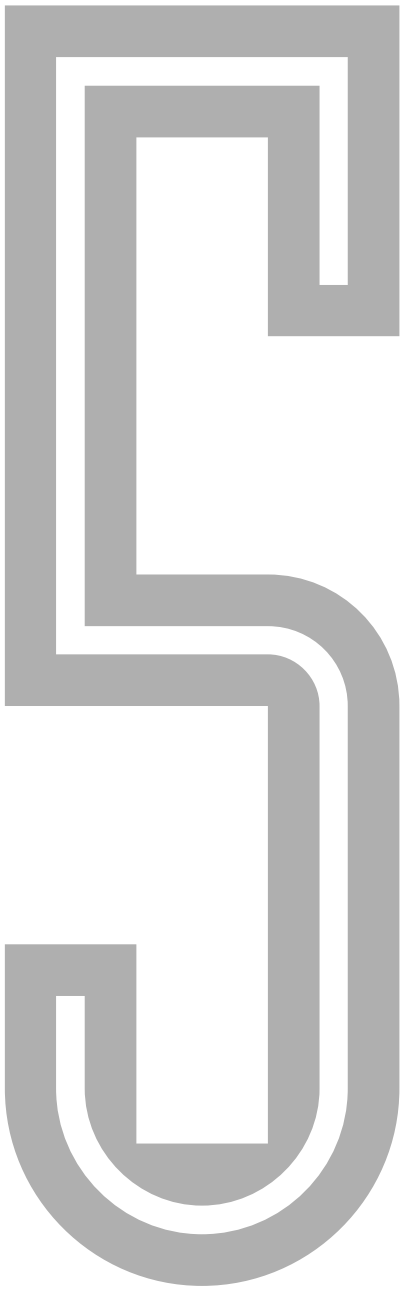

OBJECTIVES AND STRATEGIES FOR EFFECTIVE USE OF ICTS

Gajarag Dhanarajan

INTRODUCTION

In a report to the Canadian Council of Ministers of Education on *e-learning*, authors reflected:

> In the fifth century B.C., Plato predicted that the invention of writing would weaken the oral tradition that sustained poets such as Homer. Yet poetry is still alive and well 2500 years later. Similarly, 500 years ago many believed that the invention of printing, by making intellectual creations easily available, would dry up the springs of intellectual creation by ending a long-standing tradition of oral debate and expression. As we look back over the last five centuries from the vantage point of our knowledge-based society, a decline in intellectual vitality is more than a little difficult to discern, though certainly there may have been changes in some aspects of intellectual life. In fact, the existence of today's knowledge-based society is in part a testimony to the enormous intellectual energy of the last 500 years. No one would seriously argue today that the intellectual enterprise or teaching have suffered because of the invention of writing or printing.
>
> The new knowledge tools represent similarly revolutionary technologies, and we ignore them at our peril. Their potential is also clear. Online learning will be central to fostering the lifelong learning culture that will be essential to sustaining a civil and prosperous society in 21st-century Canada.[1]

The last 20 years have seen some remarkable innovations in the delivery of education. Nevertheless, many would argue that, as remarkable as these innovations are, they are no more than a beginning. Developments over the next 20 years will make, as one former U.S. secretary of education, John W. Gardner, remarked, "education as it is practiced in most schools today [look] so primitive." While this may be overstated optimism, Prof. Gardner's views are not totally unrealizable.[2] The technologies available today, and those about to emerge, have the potential to transform the business of education. However, what may be impeding that potential is our academic culture and traditions. Nine centuries of organized education have generated strong views and deep-seated beliefs about what is best and what is not.

This chapter examines the role of ICTs in the context of the global opportunities and challenges confronting the design, delivery, and administration of education to meet the diverse needs, clients, demands, goals, and objectives of nations and communities—particularly during a period of transition of societies and economies from an industrial base to one that is knowledge- and information-centered. To this end, the chapter raises a number of policy considerations and outlines a series of strategic options that could facilitate an effective role for ICT.

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POLICY CONSIDERATIONS

Cynics would claim:

> Some nations may decide to invest in technology for education for the "glitz factor": the technology is there; it is fashionable to have the latest and the best, and it gives a sense of progress to use state-of-art-technology. This can be described as the technology for its own sake rationale. Other nations may base their investment decisions on the genuine case for improving the efficiency of their education systems or for some other benefits intrinsic to education. For instance, databases and computerized records in education systems have clear advantages and benefits. This is the "technology for educational benefits" rationale. A third rationale may be external to education and concerned with developing skills for the labor market.[3]

A different view of the use of ICTs is Bill Gates's, who says: "Students can look at their grades and even turn in their homework over the Web. Teachers hold online discussion groups. Students e-mail friends and family as naturally as they call them. Students are the ultimate knowledge workers. Their 'job' is to learn and explore and find unexpected relationships between things."[4]

In between cynicism and optimism, one government took the view that it is "fully committed to ensuring that all schools and teachers are in a position to deploy new information and communication technologies [ICTs] to raise educational standards to enhance learning and to prepare young people with the ICT skills they will need in society and at work in the twenty-first century."[5]

This section considers the policy questions that drive decisions such as the one that was made by the UK government to promote the use of ICTs in its educational sector.

How Essential Are ICTs to National Goals?

This is the first question national and educational authorities have to answer. Is the introduction of ICTs into education driven by vendors, by the need to conform to world trends, is it derived from national educational objectives? Are ICTs considered a luxury or a necessity? To help answer

this question let us look at the challenges confronting countries worldwide.

Demand for More Education

The demand for more open and accessible learning has continued to increase since the early 1950s, but even more so following the World Conference on Education for All in Jomtien, Thailand, in 1989. Many factors are contributing to this changing educational culture, the most important of which are economic, social, and technological forces. These forces are worldwide in scope and power, and have had a profound impact on business practices, manufacturing processes, financial services, government policies, and, more recently, teaching practices and learning behaviors. It would not be an exaggeration to say that as we embark on a new century, we are also moving irrevocably in the direction of changing the way we think about information, knowledge, and learning.

Individuals and governments are beginning to recognize that planning for "competitive advantage" will require a labor force that has literacy and numeracy skills beyond three to six years of primary schooling (the current situation in most industrialized and newly industrializing countries, and even grimmer in developing nations). Globally, some 2 billion people who are in today's workforce will continue to be there well into the first quarter of this century. Their knowledge and skills will need continuous renewal. Added to this, we need 1 billion more young children and adults who will require initial education and training. The level of supply (or lack) of education and training for this huge demand for initial, continuous, and lifelong education using current patterns of delivery are, in the words of Sir John Daniel, "at a crisis point."[6] The challenge of providing education and training to a huge and diverse population with a variety of learning goals and styles, at an acceptable cost, will require new forms of global educational delivery. Notwithstanding the skepticism of many in the academic community, recent reports from agencies such as UNESCO, the Organisation for Economic Cooperation and Development, and the World Bank seem to say as much. In some ways, the emergence of new technologies may have something to do with the push to make drastic changes in the nature of the learning environment.

There is also a change in the nature of those requiring education and training. Communities no longer are content (nor should they be) to limit access to education and training to the fortunate few who are able; literate; live in urban communities; have access to communications, infrastructure, and classrooms; are knowledgeable about learning opportunities and options; and have the resources to pay for them. A fairer, kinder, and more concerned humanity requires that the education we provide must be made available to a broader range of historically underserved groups, including:

- Functional illiterates: Apart from about 900 million illiterates globally, there are almost half as many adults who cannot cope with the demands of daily life because they lack literacy.
- Physically disabled: Annually, in Asia alone, about 15 million people become disabled as a result of war, diseases, accidents, and malnutrition. Their major hope for self-improvement lies in obtaining needed skills.
- Long-term unemployed: Long-term unemployment is a debilitating pathology; training people in such situations poses special challenges to delivery and pedagogy.
- Out-of-work youth, especially boys: This group is highly vulnerable to socially disruptive behaviors. Youth need vocational training, including apprenticeship and self-education, to be part of a productive economy.
- Women and girls: In many parts of the world, women and girls still find themselves marginalized in education and training; ways may have to be found to circumvent the social, cultural, and economic impediments they face.
- Refugees, recent immigrants: Today, roughly 125 million people live outside their countries of origin, and this number is ever increasing. This flow of people for political, social, or economic purposes is not expected to slow down. To help these people resettle, educational programs, language teaching, and training for social and job skills must be designed and delivered.

In contrast with this escalating demand is the lack of preparedness of a vast majority of our education systems to deal even with existing demand, under circumstances that, in the words of one activist group, "violate the rights of children" through "dilapidated schools, inadequate facilities, poorly trained and under trained teachers, inadequate supplies of learning materials, irrelevant curricula, disregard for minority cultures and languages, gender bias and instructional methods which undermine, rather than nourish the potential of children."[7]

World over, the arrival of newer technologies certainly seems to have stimulated a resurgence of interest in diversifying methods of knowledge delivery. Almost daily, yet another Web-based course becomes available from one university or another. *Smart schools* are springing all over the richer world, and *virtual learning, online learning,* and other, newer forms of educational delivery are becoming part of the educational jargon of the new century. Even before the arrival of the newer technologies, institutions such as the

Correspondence School of New Zealand; the National Open School of India; the Open Universities of Sri Lanka, Hong Kong, and the UKOU; and the Indira Gandhi National Open University of India were providing good-quality, mass, flexible, and lower-cost education for remote learners from basic to university-level education using the older analog technologies of print, audio, video, and radio and television. The experience and successes of these institutions around the world are testimony to the effectiveness of technologies to reach individuals and large communities simultaneously. They have transformed the delivery of education and, in the process, also transformed the business of education.

In addition, full-time study within the timetabled constraints of the classrooms is only accessible to a few; for many who wish to study, learning has to occur at a time and place of their choice. The growth of open schools, polytechnics, and universities, as well as the numerous suppliers of correspondence and online education, are all manifestations of peoples' desire to learn at their own convenience rather than at an institution's call.

Information Explosion

It is estimated that the total amount of information doubles every four to five years. Stated in another way, the total of information available to an undergraduate in 1997 was less than 1% of what will be available to a student in 2050. Teachers have to become expert in helping learners to navigate through this sea of information rather than attempt to be effective transformers of that information into knowledge for the learners. Students must be trained to bring about this transformation, during and beyond the school years. ICTs are crucial in coping with the explosion of knowledge over the lifetime of the learner; otherwise, people's knowledge becomes obsolete, and countries become marginalized.

Citizenry in Modern Society

To function effectively in the modern world, citizens need more than a basic education. The structure and content of learning activities should equip all children, youth, and adults with the knowledge, skills, values, and attitudes they need to survive, to improve their quality of life, to empower them to participate fully and responsibly in the life of their communities and nations. This education also should help them to initiate and adapt to the changing circumstances of their environment, and to continue learning according to their individual needs and interests. Clearly, any strategy to engage all citizens in lifelong learning will require application of technologies, especially mass media. For the first time in the history of humankind, communication technologies enable us to reach millions of people across continents simultaneously. At the same time, variations of these modern technologies allow educators to tailor content to suit a narrow local audience to respond to individual learning needs. Satellite, community, and Internet-based (through telecenters) delivery of content all enrich the environment for learning. Agriculture, farming, health, market conditions, maternal care, and reproductive sciences all being delivered today through ICTs. Local community radio and telecenter facilities are extremely versatile tools and are used effectively and imaginatively around the world today (see chapter 12). The Commonwealth of Learning's (http://www.col.org) pilot projects using small, portable community radio transmitting stations illustrate how older analog technology has evolved into a newer digital tool incorporating FM broadcast capabilities and functioning as a hub for communication for rural communities (see Box 5.1).

A key feature of the modern global society is the "primacy associated with the exchange over computer-communication networks of intangibles such as knowledge, ideas and intelligence, rather than tangible goods that have long been the basis of human interaction"[8] It is also becoming fairly clear that the power of the computer chip will continue to increase while the cost of building it decreases; bandwidths will broaden and convergence heighten; and the penetration of the Internet will continue to rise while the lack of connectivity drops. Acquisition of up-to-date knowledge, skills, and education will determine the success of individuals and democratic societies both economically and socially. It is not surprising, therefore, that an ever-increasing number of countries wish to see their citizens technologically literate. From "telecenters" to "smart schools" the push to make every child computer-, Internet-, and Web-savvy has fast become an overriding concern for education ministers of developed and developing countries.

Illiteracy

Despite the knowledge explosion and advances in information and technologies, in many countries, there are significant numbers of people who cannot read, let alone enjoy the benefits of a technological society. Every country in the world has committed to decreasing drastically the number of illiterate citizens. Mass media, especially print, radio, and, to a certain extent, television, has played a significant role in adult literacy programs. In some parts of the world, newer technologies have been applied, albeit in a modest way. An increase in the use of ICTs seems to be constrained by financial resources, shortage of literacy workers skilled in using technologies, and lack of technical support for a well-functioning technology environment. However, ongoing developments using online resources to train literacy workers and

BOX 5.1 • COMMUNITY RADIOS PROVIDE NONFORMAL EDUCATION AT LOW COST

Radio systems, such as the portable solution the Commonwealth of Learning (COL) and others have used in community FM radio initiatives, also can be effective in delivering education to the masses without the high infrastructure costs associated with radio broadcasting. Community broadcasting can address local needs through locally produced programming, but it can also provide a tremendous variety of quality educational content freely available for rebroadcast, from national and international sources, through satellite or the Internet. Care should be taken, however, to ensure that rebroadcasting is balanced with the needs of the local community and the provision of appropriate and relevant programming content. Low-cost, portable, suitcase-size community broadcasting stations have been set up by COL in Belize, Guyana, Namibia, and South Africa, as has a solar-powered version in Uganda. The stations broadcast a wide range of educational and informational services tailored to meet local needs. Associated training on program production and broadcast technology has been provided to local operators. Also, in cooperation with the Sri Lanka Broadcasting Authority, COL supplied and provided training for a portable FM radio station as a broadcasting and journalism training aid and, in collaboration with the Commonwealth Educational Media Centre for Asia, the Sri Lanka Open University, and the Ministry of Agriculture, a Rural Communication Research Project has been initiated to integrate traditional and experiential knowledge with modern scientific advances. The project's findings will be shared through audio broadcasts to educate rural communities on environmental conservation and sustainable development. Given its availability, accessibility, cost-effectiveness, and power, radio represents a practical and creative medium for facilitating mass education in rural settings.

create literacy products seem to demonstrate significant results. ICTs have the potential to:

- reduce the isolation many adult literacy providers and students experience;
- facilitate communication among staff and students within and between programs;
- increase access to high-quality materials and emerging research;
- streamline administrative and reporting processes; and
- help to provide the delivery vehicle for innovative instructional and staff development approaches.[9]

Short Supply of Talent

On one hand, the planet is filled with highly skilled and talented people in all fields of human endeavor. On the other, critics of global educational systems constantly bemoan the fact that, by and large, the academic talent needed in our schools, colleges, and universities to enhance the quality of the learning environment beyond perceived levels of mediocrity is in short supply. We need excellence in our teaching, and we need to obtain our teachers from the best in the local community and distribute them to the whole learning community. The Western Governors Virtual University[10] initiative among the northwestern states in the United States is in fact an attempt to do this. This attempt envisages going beyond campus walls to obtain academic "teaching" talent. Contributors to courses will come from business, commerce, industry, and government, and those who take the courses will include ordinary people, along with thousands of college and university students.

ICTs for What Educational Objectives?

Planning for effective use of ICTs in education necessitates understanding the potential of technology to meet different educational objectives and, consequently, deciding which of these objectives to pursue. This decision affects the choice of technologies and the modalities of use. This section structures the discussion around four objectives that may be enhanced by ICTs:

- expanding access to all levels of education;
- improving the quality of education;
- enhancing lifelong learning; and
- facilitating nonformal education.

Expanding Access for All to All Levels of Education

In most developing countries, full-time study within the time constraints of classrooms is only accessible to a few; for many who wish to study, learning will have to take place at a time and location of their choice. In addition, access to learning for those living in remote areas and those who are marginalized, isolated, or disadvantaged has to be sought vigorously as nations respond to the declaration made at Dakar in 2000.[11] Either synchronously or asynchronously, barriers such as time, distance, and social and cultural constraints must be overcome. At the same time, rapid changes taking place in the workplace will require training to be delivered quickly. Such

training must be high-speed, low-cost and capable of reaching small and large groups. As a policy consideration, the application of ICTs to enhance access to learning must receive the highest priority. ICTs in their many forms have been applied in a variety of contexts, including:

Reaching Learners in Remote Communities

Provisions have to be made to reach, in particular, children in many parts of the developing world where formal schooling is likely to account for less than 1,000 days in their entire lifetime. Fewer than half of primary-school-age children actually are enrolled in school, and more than two-thirds of those who do manage to enter school fail to complete three years of schooling. While it will take a massive effort to change this situation, as an interim measure, ICTs can be employed in formal and informal settings to deliver essential knowledge and information. The National Open School in India, using print, audio, local tutors, and ICT-based assessment and testing system on-call, provides postprimary education to remote villages throughout India. About 400,000 children have access to education up to grade-12 equivalence, and lessons prepared by teams of highly qualified teachers are made available to students free or at very low cost[12] (see Box 5.2).

Taking Education to Girls

Gender disparity in educational access is a major challenge in many communities because of family and social circumstances. Inequalities between women and men extend from literacy classes to access to formal schooling and prospects for completing school. Social, cultural, religious, and economic factors all combine to create barriers and place girls and women at a serious disadvantage. While such barriers will take time to remove, ICTs provide one way to circumvent them. Learning and training will have to find their way to girls and women where they are located, rather than expecting them to come to places where teaching is conducted. The Allama Iqubal Open University of Pakistan approached the challenge of illiteracy among women in Pakistan through a unique combination of print, audio, radio, and mentors.[13] Though all the technologies used were analog, the opportunity to digitize this effort and deliver it through local telelearning centers offers immense opportunities, in both qualitative and quantitative terms, to scale-up the effort.

Providing Learning Opportunities for Individuals in Challenged Circumstances

Increasingly, ICTs are being recognized and used to bring education and training to those individuals who are challenged in one way or another. These tools include digital voice control software, audio to visual conversions for the hearing impaired, electronic text, and digital audio. The technologies, either stand-alone or as part of integrated systems, help to overcome barriers such as instruction based only on print and dependent on sight, audio dependent on hearing, and video requiring vision. The systems themselves have to be developed for individual use, so they require careful study of individual students' needs. Vincent[14] describes a few such approaches taken by the UK Open University where print-based courses are adapted using ICT to enable challenged individuals to benefit from them.

Providing Education for Out-of-School Youth

Education of out-of-school youth, especially beyond the basic level, can benefit from the application of ICTs. Vocational and trade skills, competency-based training, and alternate entry paths to higher education can be achieved through creation of knowledge products for a variety of situations, from self-learning to flexible learning environments. Multimedia commercial training products are becoming increasingly available for training in vocational skills. Governments can play an important role in enabling vocational training institutes, encouraging nongovernmental organizations (NGOs) engaged in supporting youth development, and prodding media outlets to use ICTs for youth training and personal development.

BOX 5.2 • NATIONAL OPEN SCHOOL, INDIA

The National Open School (NOS) India was established in 1989 to support India's National Policy on Education. The school caters to the needs of school children as well as children from socially marginalized communities in both urban and rural locations. While the school's early focus was on academic programs at the secondary school level, it currently offers courses in vocational and other life-skills areas. It also has extended its range from elementary to preuniversity programs. Some 400,000 children are enrolled, and they come from challenged communities, socially disadvantaged groups, and isolated populations. The school uses ICTs for course development, administration, testing, and to deliver some content by audio and local radio. Its plans for the future include even more extensive use of the newer technologies through tele- and community-learning centers.

Creating Open and Virtual Learning Environments

Smart schools, online education, and *virtual universities* are labels that have been attached to institutes applying a new set of strategies to deliver education using digital networks either synchronously or asynchronously. The technologies are used to deliver instruction, to manage the system's administrative services, and to provide support for learners. The last four decades have seen the emergence of colleges and universities dedicated to delivering tertiary-level education off-campus to learners, especially in those countries where the gap between the supply of and demand for tertiary-level education is huge and largely unmet. These universities apply open learning principles and distance education practices to deliver learning. They are generally universities with big student populations comprising mature and mostly part-time learners. Ten of the largest universities in the world are open universities, and all but one of them is located in developing countries. In total, they may have as many as 2 million students enrolled in their programs.[15] ICTs have always played an important role in managing and administering these universities, and older analog technologies such as radio and video also have been used to enrich the learning environment of the open universities. With the arrival of the newer digital technologies, ICTs also have begun to figure much more intensely in this role.

Improving the Quality of Learning

One of the most powerful reasons for considering using ICTs in an educational system is that they put learning in the hands of the user. They facilitate individualizing curriculum, permit learners to dictate the pace of learning, and widen sources of information. ICTs also promote active learning and allow for interaction between and among peers and mentors. Many would say as well that the quality and effectiveness of learning is enhanced many times through the use of ICTs. The technologies allow faculty to incorporate new information and update learning materials, and they enable immediate and rapid transfer of information pertaining to the administration of a course or program of study (see chapter 3). Of these many educational objectives, the five below stand out as extremely important.

Curriculum Enrichment

The Delors Commission report[16] to UNESCO clearly and eloquently described the need to reform curriculum at all levels of education to prepare citizens for the new millennium. Learning to know, learning to do, learning to be, and learning to live together are all ideals that are achievable within the framework of basic and postbasic education. These recommendations recognize that today's learners, young and old, will spend their lives in a century that is information-rich, knowledge–dependent, and global. They need the skills to cope with this dynamic period. The growth of online library systems, easy access to expert knowledge through the Web, the variety of sources of learning, and frequent change of careers and location of residence during a person's productive lifetime will necessitate learning new skills and refreshing old skills. The curriculum should reflect these concerns and will include:

- The ability to frame problems when facing unfamiliar situations. Tomorrow's problems may be similar to yesterday's once they are well understood. But these present themselves in new forms. Once a problem has been framed, it must be solved and, often, both framing and solving problems will require powerful information technologies. Framing and solving problems sometimes will be simpler, but they often are likely to be more difficult than before.
- The ability to communicate, including with people from other groups. Nations' ethnic composition is becoming more diverse, and increasing globalization has meant having frequent contact with people of other nations and cultures. All of this requires sensitivity to numerous cultures, and some common and shared values and insights, if political and social tensions are to be avoided and conflicts minimized.
- The ability to work in, form, and lead teams and coalitions, including involving people of other cultures. This vital skill is seldom taught comprehensively in schools, and, as global interdependence increases in importance, so, too, does collaboration.
- The ability to identify what needs to be learned, and then learn it efficiently. ICTs often will furnish the means for learning. Every educated person will need to spend a certain fraction of his or her life keeping up with changes in that technology.

In all these areas, ICTs are an extremely invaluable asset. The Web, more than any other tool we know of, has the power to make enormous amounts of information from their original source available at the click of a button. This information, in its multimedia form, provides teachers and learners with information to support and enrich curriculum in the modern classroom. Subscriptions to digital libraries, collaborative projects with peers outside of one's own classroom, and access to remote knowledge and expertise make lessons richer in content and, in the process, learning more exciting.

Flexibility

The time-driven, rigid organizational structures of our institutions of learning, our assumptions of learning, and our traditions of teaching, as well as the urban location of

teaching institutions, have combined to present barriers of one kind or another to learning for all but a small proportion of citizens. The new ICTs provide enormous flexibility of use unlike older technologies, which required learners to be assembled in a controlled environment at a specific time and location. Radio and television had to be tied rigidly to schedules developed centrally. On the other hand, the new technologies are available for use "anytime, anywhere." The emergence of virtual education is very much a reflection of this versatility: Learners can access their education or training at the workplace, home, library, or anywhere connection to a telephone and power supply is available.

Transformation in the Teaching/Learning Process

Learning technologies can affect education in systemic and structural ways. The challenge for educators is to bring about a balance among content learning, technology learning, and social experience. This balance depends on instructional strategies that accommodate individual learning styles and, at the same time, provide for effective assessment. Successful introduction of ICTs into the learning environment also includes support for interdisciplinary interaction with peers and instructors and among groups. This arrangement allows learners to interact with their institutions and their communities.

The newer technologies can change the relationship between teachers and learners to improve the learning process and learning experience. Traditional teaching and learning habits always have favored a certain passivity. Professors lectured and students listened and took notes; sometimes they asked questions, but they seldom contributed to knowledge. That was also true for the older technologies of print, radio, and television, despite the hype given them. Though active and independent learning were aspired to, they were hard to achieve, given the limitation of the technology. New ICTs make it possible for students to be active learners. Both teachers and students can control, manipulate, and contribute to information and knowledge generation. Using ICTs, students not only make choices about the pace and order of a presentation, but also may choose topics for explorations; take notes; answer questions; explore virtual landscapes; simulate experiments; enter, draw, or chart data; create and manipulate images; make their own PowerPoint presentations; and communicate with others.

ICTs have great capacity to facilitate the educational transaction between providers and users. For instance, ICTs can be used to:

- *Keep students well informed* about the courses that are available to them.
- Enhance *teacher-learner contact,* an essential part of a good educational environment, through e-mail, chat sessions, etc.
- Encourage *active learning*. Students do not learn much from memorizing facts and reproducing set answers; they derive greater benefits by being active in their learning.
- Facilitate *peer support in learning*. Sharing one's ideas and responding to the ideas of others improves thinking and increases understanding. Learning can improve if it is a team effort rather than a collection of solo performances.
- Provide immediate *feedback and encouragement*.
- Encourage *paced learning* through tools such as assignments, tutorials, broadcast programs, computers, conferencing, etc.
- Allow for effective mapping of *learning pathways,* which facilitate different styles of learning.

Professional Development of Teachers

Like all other professions, teachers need constant and continuous renewal to be effective, motivated, and up to date in their knowledge and skills. While this is not a mandatory requirement in many national jurisdictions, those that do have such requirements use and see ICTs as important vehicles to provide continuing professional development to teachers. The use of ICTs, especially in support of distance education activities, adds enormous value to the training. Where the infrastructure exists, and connectivity costs are subsidized, the opportunity to create virtual online learning communities of teachers within nations and across regions exists. Such learning communities enable and empower trainee and practicing teachers to share experience, curriculum, learning materials, lesson notes, and collaborative projects. ICTs can be applied in at least three training contexts: basic training, upgrading and advancing pedagogical skills and content knowledge, and continuous professional development. (For a full treatment of this topic, see chapter 8.)

Resource Sharing

Though we have shared knowledge through the wonderful medium of books, only a fraction of human knowledge actually is published. Until the arrival of the computer, sharing knowledge, an important basis of education, was more wishful than real. With ICTs, sharing knowledge resources is enhanced many times over. Putting information on the Web makes it available immediately to anyone in the world with a suitable connection. Teachers can share lesson plans with their colleagues in their own jurisdictions and with those far removed from their jurisdictions. Students from all over the world can undertake joint

projects, exchange findings, analyze data collectively, and draw reasoned conclusions. Knowledge about and of interest to minority groups, languages, and interests can enjoy the same opportunity to publish and share.

Enhancing Lifelong Learning

Lifelong learning is a necessity in a world that changes and renews itself so rapidly. Such dynamism makes demands on individuals to update themselves constantly in the context of their workplace, social life, and participation in healthy and vibrant democracies. Two broad categories of individuals use lifelong learning opportunities.

- The first group refers to those who are underrepresented across a whole range of postbasic education and includes, among others, illiterate and neoliterate populations engaged in unskilled work; ethnic, marginalized, and minority groups; people with learning difficulties; and the physically challenged. These learners face such obstacles as lack of learning skills, confidence, money, counseling and advice, and personal support, and they require active intervention by the state, the business sector, and voluntary organizations.
- The second group refers to those who have had the benefit of some form of postbasic education but are not equipped to deal effectively with the technology-driven environment in which they find themselves. This group includes out-of-school youth, employees in workplaces, individuals with basic training, professionals needing continuing education, and older adults seeking personal enrichment. These people are expected to know their needs, but they face challenges such as inadequate supply of learning opportunities, inflexibility of learning systems, lack of money, and inadequate supply of information.

There is increasing evidence that ICTs are beginning to play an effective role in promoting lifelong learning. Supported by a greater bandwidth capacity, digital and interactive radio and television, and multimedia, pathways are extending the speed with which learning products can be delivered to learners over large catchment areas. However, to make this happen, some basic conditions need to be met, including regulatory frameworks, infrastructure, affordable cost structures, public access to multimedia facilities, skills training in ICT use and employer support, and institutional commitment of learning providers.

Continuous Education of the Workforce

As shifts occur in economic activity, so does the need to "retool" the workforce in response. This applies as much to a rice farmer as it does to an ICT worker. To maintain and enhance the competitive advantage of their workforces, nations are beginning to give more attention to training or retraining people. In a world made up of some two billion workers who will require regular access to training where they are working, the role of ICTs becomes critical. In British Columbia (BC), Canada, for example, a program called SkillPlan[17] does exactly that. The training facility was developed as a result of a partnership between the Open Learning Agency (OLA) of BC and the province's Construction Industries Unions. The OLA identified a computer-managed learning system that provided adult basic education courses aimed at those who had completed high school certification. Workers who need to improve their reading and writing skills can "drop in" at the Agency's local centers and use the system when it suits them. The system keeps track of each individual's progress and enables learners to carry on where they left off the last time they were able to drop in. The training center is equipped with ICT appliances and connections such as telephones, fax, and online. Another example of a dynamic arrangement is the Queensland Open Learning Network[18] (see Box 5.3).

Just-in-Time Training

The rapid changes taking place in the workplace will require training to be delivered quickly. Such training needs to be high-speed, low-cost, and accessible to small and large groups. Traditional ways of delivering training are time-consuming, labor-intensive, socially disruptive, and expensive. Workers have to acquire new skills quickly and affordably. It becomes even more attractive if such training can be delivered at the trainees' workplace. Also, adult learners require flexibility, and they have families, work commitments, and social obligations around which they have to fit their training. This simply means that, ideally, training has to be accessible anywhere, anytime. Just-in-time-training is especially relevant in the context of business and industrial training where there is a continuous need to respond quickly to demands from the work environment.

Facilitating Nonformal Education

ICTs are being used to make information and knowledge available in nonformal contexts. The demand for enrichment learning is on the rise, particularly in countries experiencing an increase in aging populations and in populations with more leisure time who want to use it in intellectual pursuits. These are learners for pleasure, and, for them, activities in a classroom are not the ideal solutions. ICTs offer a convenient solution, but only if the individual has the skills needed to use the appliances and navigate through the millions of Web pages and is able to pay for the cost of the digital connection.

Besides structured learning for enrichment purposes, unstructured learning opportunities are increasingly available

BOX 5.3 • THE QUEENSLAND OPEN LEARNING NETWORK

The Open Learning Centres of Queensland, Australia, are fully wired telelearning centers, managed by local communities under the oversight of the Queensland Open Learning Network [QOLN]. Its main function is to provide locations where citizens can access formal accredited programs of study from colleges, universities, and other providers. The Centre also receives specially tailored programs from the QOLN. The Centre's aim is to foster lifelong learning and motivate and empower people to acquire new knowledge, skills, and understanding so they can lead fuller and more productive lives capable of adapting and responding collectively to new circumstances and environments.

The Centres are equipped with a network of computers with shared peripherals, software applications, software and hardware facilities for multimedia learning, printing and photocopying facilities, Internet access, phone, fax, and audio, video, and audio graphic conferencing facilities. Each telelearning center is managed by a local coordinator who also acts as "community learning leader."
The Centres' four main functions are:

- program design, from needs assessment to developing program specifications;
- program development, including sourcing and evaluating existing course materials, access to online technologies, and matching training aims with open learning strategies;
- program delivery and support—training trainers, tutors, and local content experts and providing learning materials; and
- program management and administration—developing appropriate systems, processes, and strategies and identifying fiscal and human resources.

through zoos, museums, planetariums, research institutions, professional societies, interest groups, commercial companies, and national agencies, among others. The knowledge to be gained can range from virtual tours of, for example, archeological sites to the epidemiology of HIV/AIDS. It is as possible to learn to cook exotic food as it is to design and make quilts. One can participate in a debate on the World Trade Organization organized by supporters or detractors or engage in a discussion with a Nobel laureate on rain forest exploitation. All of these learning opportunities inform citizens, enrich their lives, enable them to share indigenous knowledge, and empower them to participate in functioning democracies. The British government, for example, plans to connect all of the country's libraries to the Internet through a National Grid for Learning.[19] In theory, this will allow citizens to browse through holdings throughout the country, a service that is especially valuable to those who are homebound.

STRATEGY QUESTIONS

Strategic planning for inclusion of ICTs in a nation's or institution's educational system is likely to be based on a number of perceptions, such as:

- acceptance of a learner-centered educational approach that involves the use of multimedia resources for self-paced, self–directed, flexible learning;
- acceptance that the role of teachers is changing from transmitters of knowledge to mediators in learning from a variety of information sources;
- the belief that systems that include technology can improve efficiency and/or effectiveness of student learning; and
- a perception of accelerated growth in demand among stakeholders for access to technology coupled with a rise in availability and use of ICTs elsewhere in society.

Strategic planning questions about the use of ICTs in education invariably will include a need to recognize the competing interests of stakeholders. It will be particularly important to align the learning technology strategy with strategy planned for related areas such as libraries and information systems, academic management (student records, accreditation's, credit banks, etc.), student support systems, student administration, and electronic media. In relation to ICTs for education, there are three basic questions:

- Which technologies?
- How will they be used?
- Will contentware by created or acquired?

Which Technologies?

Even as recently as 10 years ago, the choice of technologies for delivering education was somewhat limited, partly

because they were expensive, analog stand-alones with limited versatility, and they required skilled technicians to create and deliver the product. Radio and television are prime examples of the demand these technologies made on educational systems. Those that did not fall into this category, such as overhead projectors, slide projectors, etc., had limited reach. Today the picture has changed almost completely. Technology application in education no longer is limited by the versatility, convenience, cost, and potential of the technology but, rather, only by our imagination in the way technology can be applied. Through integration, convergence, miniaturization, and intelligence, technologies have become friendly. The question is no longer whether technologies are useful in the teaching and learning environment but which technologies are best suited for a particular purpose. Digitization of many information and communication technologies has made it possible to design, develop, deliver, manage, and assess the learning and training process.

The new digital technologies are not single technologies; they are combinations of hardware and software, media, and delivery systems. They are evolving and converging rapidly, as seen in PCs, laptops, notebooks, and digital cameras that are both video and single-image; local area networking; the World Wide Web; CD-ROMs and DVDs; application software, such as word processing, spreadsheets, and simulations; e-mail; digital libraries; and computer-mediated conferencing, videoconferencing, and virtual reality. They also have a capacity to integrate with older analog technologies from print, and through audio and video, make it possible to retrieve information stored in older technologies and to develop synergies between the old and the new. There are excellent reviews of the older analog technologies, which still have tremendous value, especially in many developing countries and their educational systems.[20, 21, 22, 23]

This section of the chapter focuses on newer technologies, which are mostly available to and used in developed countries for education, but hold tremendous promise globally in both rich and poor communities. They also differ in several important aspects from older technologies in their integration of multimedia, convergence of communication and information technologies, interactivity, flexibility of use, and connectivity. Understanding these differences will help us to appreciate why the use of ICT in education is expected to grow.

ICTs for teaching and learning range from those that rely on ubiquitous low-cost technology, such as the stand-alone PC, to those deployed for specific purposes at higher cost, such as the electronic classroom. Decisions on the choice of technologies are subject to many considerations and constraints, ranging from constancy of power supply to availability of skilled technical and managerial support to maintaining the technological infrastructure. Assuming these are available, then questions of pedagogical strategies of the system, accessibility, scale, and cost will play a role in the choice. Some of the newer IC technologies available and used today are discussed below.

E-mail

Increasingly, e-mail is becoming the most widely used medium, ranging in function from exchange of gossip, to serious dialogue and collaborative research. It also has become an important supplement to classroom teaching. Bulletin board services extend the classroom beyond fixed timetables; listservs bring communities of learners together; and assignments and term papers are beginning to be channeled routinely through e-mail. On-campus education is being enriched by e-mail facilities, and off-campus education is made more personal and interactive. In economically developed countries, e-mail is almost as common as the telephone. In many cases, connections are free of charge, appliances are provided at low or no cost, and training is available for neophyte users. In poor economies, e-mail has yet to make its presence felt throughout society, but is increasingly available at community service centers such as libraries, telelearning centers, and "cyber cafes."

Presentational Software

PowerPoint and similar programs are already commonplace among academics and other professionals. While a simple slide presentation requires little skill to develop, the increasing sophistication level of such a presentation requires higher-level training.

World Wide Web

Many on-campus instructors are beginning to use the Web to make their lecture notes available to students at any time. The Web also has the advantage of providing access to primary sources of information in most media (print, graphics, photographs, audio, and video) through streaming. This technology requires good organizational and pedagogical skills to profit from its enormous potential, and faculty training in its use will be essential. Bates[24] considers the Web to be a low-cost technology for several reasons: the existence of simple computer languages such as HTML and intermediary course authoring systems such as the WebCT and Blackboard; it uses the Internet as a transport vehicle that involves no direct charge for independent packets of information, and pricing is by volume and not by time or distance; the Web's ability to combine media, thereby increasing its range of applications; access to high-quality learning resources inexpensively; it allows asynchronous interpersonal communication through e-mail, bulletin

boards, and discussion forums; and it enables cross-cultural, international, collaborative learning.

Multimedia, CD-ROM, DVD

Multimedia, CD-ROMs, and DVDs are very exciting learning tools. Their development costs can be very high, especially those at the very high end that can carry large quantities of data in a variety of formats, such as audio and video clips, Internet connections to other databases, large amounts of information, and built-in simulation and other enrichments. Putting all these together in user-friendly packages will require teams of experts, from media producers to content experts. The reproduction cost of CD-ROMs can be reduced considerably if large numbers are "burned." Consequently, this medium is a consideration only when enrollments are large enough to justify the development expense. However, there is a strong case for developing the medium when the course can be used by a consortium of institutions working together.

Satellite Broadcasting

Satellite broadcasting for educational purposes has a long history. Countries such as India[25] and China,[26] and such regional universities as the University of the West Indies[27] and University of the South Pacific[28] have long used satellites to deliver audio- and video-based lectures to all corners of their region. Satellites serve as good vehicles to carry lessons, and, by marrying satellites to ground facilities, it is possible to build a two-way learning environment. In addition, their digital technologies allow for further sophistication to be built into the learning systems. However, because of their high start-up cost, satellites' value for educators is limited. Recent developments sponsored by private enterprises such as World Space have combined satellite technologies with digital ones to broadcast voice and data directly to specially designed digital receivers over very large geographic areas. While this venture is driven by and for commercial interests, special provision for educational purposes allows educational providers to reach very remote and isolated parts of the world. World Space eventually expects to reach an audience of some 3 billion people. While satellite technology has some significant advantages in terms of reach and low unit cost, for it to be truly effective as a learning technology requires extensive local support on the ground, either on an interpersonal basis or through telephony, the Internet, etc. Ground support will cause costs to increase considerably, thereby reducing the economic benefits. As Bates[29] concludes, "well designed printed texts can be more educationally cost-effective than real time or even recorded satellite lectures."

Videoconferencing

In the late 1970s, multicampus postsecondary institutions began experimenting with videoconferencing to distribute their education and training services and lectures in real time. With the decreasing costs of telephony, videoconferencing has become relatively popular, especially in Australia and the United States. This technology, an amalgam of telephony and computer-compressed technologies, reduces the amount of time instructors and students spend traveling from campus to campus to deliver and receive lessons. It also saves instructors from having to repeat lectures. The traditional culture of classroom teaching is preserved, and no new skills have to be learned by students or teachers. It is not a flexible system of learning, however. New innovations incorporating videoconferencing technologies with the Internet and Web technologies offer new opportunities, notwithstanding some concerns about the visual and voice quality of such arrangements.

How Will They Be Used?

Broadly speaking, ICTs can be used for either one of two purposes, or, in some cases, for both purposes simultaneously. The first purpose is to enhance the richness and quality of education on-campus and in the classroom; the second is to distribute campus-developed knowledge products off-campus through distributed learning, distance education, and open flexible learning. In either case, the selection of technological tools will depend on costs, the technology infrastructure of the learning system, learner access to the technology, the support personnel and facilities available to create digitized knowledge products, and the institutional commitment to sustaining the venture. Based on an extensive survey of European universities, and embedded in a few assumptions relating to the use of technologies, the Association of European Universities—under the sponsorship of the European Union's Socrates program—developed a set of guidelines for using ICTs[30] (see Table 5.1). Under the right conditions and used properly, the technologies can be highly effective as both teaching and learning tools. The challenge for institutions is to develop the knowledge and skills to exploit the technologies' full potential.

Create or Acquire Contentware?

At the heart of all learning that uses ICTs are materials specially designed to exploit the full potential of the available technologies. These materials normally include content in the form of texts, special "books of readings," specially developed study or learner's guides, assignments and assessments pads, and instructor's or tutor's guides. These resources, along with appropriate learner support systems, complete the educational or training environment. There are two ways by which institutions acquire these learning and teaching

TABLE 5.1 • ICT APPLICATION TO SUPPORT EDUCATION

TECHNOLOGY STRATEGY TO SUPPORT PEDAGOGICAL APPROACHES	PEDAGOGICAL TACTICS AND EXAMPLES	TECHNOLOGY INFRASTRUCTURE REQUIREMENTS
Using tools and templates	*Individual or group projects by students* > Course work preparation, building models, simulations, programming > Web page construction	> PC486 (nonmultimedia) > Pentium multimedia > Stand-alone or networked > Individual ownership or provided on campus
Using models/simulations	*Individual self-paced learning* > Enhancing textbook and other resources; > "Virtual" laboratories/workbenches > Typically developed by publishers or consortia of university	> PC486 (nonmultimedia) > Pentium multimedia > Stand-alone or networked; possibly accessed via Web (e.g., Java applets) > Individually owned PC, subject to ability to license individual copies; otherwise confined to campus-based PC workstations
CSCW environments (computer-supported collaborative work)	*Collaborative learning* > Support for group work > Mediated class discussion > Group & individual projects	> PC486 (nonmultimedia) > Pentium multimedia > Connected to a network, accessible on-campus only or accessible from off-campus > University must maintain host server; CMC (computer-mediated communications) software (groupware) required > Can be Web-based (e.g., TopClass) or proprietary
Electronic mail	*Student-teacher and student-student communication* > Improved access to academic staff, submission of course work, feedback, advice, and discussion > Allows asynchronous dialogue	> PC486 (nonmultimedia) > Connected to a network, accessible on-campus only or accessible from off-campus > University must maintain host mail server
Video- and/or audioconferencing and audio graphics	*Outreach to remote tutorial groups; institutional collaboration* > Use generally confined to small groups at senior, undergraduate, or graduate level	> High-quality videoconferencing systems require dedicated rooms, typically 2 or 3 cameras, microphones, and some form of electronic "whiteboard" or method displaying computer-projected images at both ends; high-grade telecommunications links are typically required—e.g., ISDN. > Small-scale videoconferencing can be achieved using PC with video card and top-mounted camera. Systems often use proprietary software, and networking between systems is not always adequate. Subject to networking, control software can be used to allow shared working on files in standard formats—e.g., word processing, spreadsheet, CAD. The tutor may transfer active control to/from remote locations, and all participants view the active image on their local screen. > High-grade telecommunications lines are normally required. > Limited workability is possible over the Internet.

TABLE 5.1 • ICT APPLICATION TO SUPPORT EDUCATION (CONTINUED)

TECHNOLOGY STRATEGY TO SUPPORT PEDAGOGICAL APPROACHES	PEDAGOGICAL TACTICS AND EXAMPLES	TECHNOLOGY INFRASTRUCTURE REQUIREMENTS
Lecturing/demonstrating	*Audiovisual presentation* > Support for lecture-style presentations incorporating audiovisual/multimedia elements	> Fixed projection installations in large or medium-size auditoria. > Fixed video and/or PC consoles or facility for presenter to connect laptop computer; portable projection devices for smaller rooms: LCD projection panels, connected to PC for use with overhead projectors. > Data projectors: self-contained units with built-in light source.
Broadcasting	*Extension of conventional lecturing* > Elements of distance education programs, providing off-campus access to traditional stes of teaching. Sometimes used in combination with audioconferencing or simple telephone to provide feedback/questions from remote sites. Lecturer frequently delivers lecture simultaneously to live audience on campus. Broadcast can be terrestrial or by satellite.	> TV technology > Normally uses dedicated classroom, with 2 or more cameras, controlled by lecturer
Hypermedia resources	*Course resources for self-paced, self-directed learning or for private study directed by teacher* > Corpus of loosely structured documentation, including multimedia (sound, graphics, animation, and video) with embedded hypertext links > Can be made available on CD-ROM or via the Web	> Pentium multimedia PC > Stand-alone (CD-ROM) or networked (WWW)
Didactic courseware	*Self-paced learning* > Computer-based training (CBT) or computer-assisted learning (CAL) resources, typically used in highly structured didactic format, with sequential lessons, examples, and tests; may replace or supplement aspects of conventional teaching	> PC486 (nonmultimedia) > Many CBT applications do not require multimedia facilities and may be loaded directly from floppy disk > Pentium multimedia > Stand-alone or networked, for CBT/CAL courseware that makes use of multimedia—typically distributed on CD-ROM > Use off-campus may be limited, depending on terms of copyright or site licensing
Automated testing/feedback	*Assessment* > Can be used for systematic objective testing > Useful where large class groups are to be tested and where subject matter lends itself to this type of test > Includes banks of test questions, automatic marking and generation of feedback to students, summary information on student performance for teachers	> PC486 (nonmultimedia) > Connected to a network, accessible on campus only or accessible from off-campus (depending on provision of site license for relevant test management software)

TABLE 5.1 • ICT APPLICATION TO SUPPORT EDUCATION (CONTINUED)

TECHNOLOGY STRATEGY TO SUPPORT PEDAGOGICAL APPROACHES	PEDAGOGICAL TACTICS AND EXAMPLES	TECHNOLOGY INFRASTRUCTURE REQUIREMENTS
Intelligent tutoring systems (ITSs) (adaptive courseware)	*Self-paced learning* > Adaptive courseware extends the CBT/CAL approach by seeking to customize "lessons," based on dynamically modeling individual student performance	> PC486 (nonmultimedia); ITS applications do not always require multimedia facilities > Pentium multimedia—stand-alone or networked, for courseware that makes use of multimedia—typically distributed on CD-ROM > Use off-campus may be limited, depending on terms of copyright or site licensing

resources: they design and develop them either by themselves or in partnership with like-minded collaborators, or they purchase, lease, or acquire—through other arrangements—materials already developed and adapt them for their unique needs.

Materials Creation

Developing interactive multimedia learning materials is an exceedingly interesting challenge. They can be constructed from a combination of media, sometimes quite modest in cost and sophistication, such as a combination of computer-aided instruction (CAI) and print, and at other times very expensive and elaborate, using a combination of DVD, CD-ROM, hypermedia, and virtual reality. Discussing this issue, Miller[31] compared the process of production to

> an orchestra in which each musician not only plays a different instrument, but also speaks a different language. Such is the case with interactive video, where the assembled team includes instructional designers who speak of authoring, pedagogics and remediation; graphic artists who talk of drop shadows, GUI's and animated sprites; video producers who think in terms of wipes, fades, pictures, plots, scenes and storylines; and computer specialists who deal in bits and bytes, images and data, icons, picons, microns and programming language all their own. Add to this a systems person who wants to integrate DVD's and CD-ROMS and Windows via SCSI or R232 ports, and then telecommunicate the whole mess to a host...

Despite the complexities involved in the design and creation of multimedia materials, it is important to plan before developing and producing learning materials that integrate print, audio, and video into a seamless and fluid learning experience. (For a full treatment of multimedia materials development, see chapter 7.)

For well over three decades now, and long before the arrival of the newer technologies, dedicated distance teaching institutions such as the open universities of the UK, Canada, India, Thailand, Turkey, Israel, South Africa, and other countries have been developing courses using a variety of media. The experience gained through these institutions is just as relevant in today's technology-rich environment, where digitization allows for totally seamless integration, as it was then in an analog world. Unlike face-to-face teaching, the design and development of interactive multimedia materials involves the knowledge, skills, and expertise of a number of individuals. Therefore, assembling a team to undertake the task is almost a prerequisite if a high-quality product is the ultimate objective.

The size of the team, and the skills of the individuals who make up the team, will depend on the sophistication of the product to be developed. It is possible, though not advisable—as is often the case in many small operations—for one person (normally the content expert) to create the learning materials. At a minimum, the course team should have a content expert and an instructional designer. In addition to content experts and instructional designers, complex course team composition may involve audio and video producers, editors, ICT specialists, publishers, and project managers. The team approach will require a totally different work culture from what is normally associated with academe.

Materials Acquisition

Digitization of knowledge products opens up unprecedented opportunities for their portability. CD-ROMS, DVDs, and other multimedia have the capacity to carry entire courses on a single disc. Furthermore, granulation of knowledge allows for greater manipulation of the content to suit particular needs and clients. There are also economies to be gained. However, acquiring knowledge products from other sources for local use requires careful consideration of many issues and factors, besides intellectual property rights and

economic concerns; sometimes it is cheaper to produce courses in house than to purchase and adapt them. Questions to be asked before acquisitions include:

- Does the product meet national and/or institutional objectives?
- Does the product contribute to the aims and objectives of the course?
- Is the content current, unbiased, and politically and socially sensitive?
- Is the use of text and media appropriate for the needs and objectives of the course?
- Can the product be used with locally available resources?
- Is it cost-effective to purchase the product?
- How well does the product fit the local learning environment?
- Does the product create barriers to learners (language, cost, technology)?

Each question requires a carefully considered response to make the right decision about acquisition. Broadly speaking, three types of factors influence that decision:

General Factors

These factors apply to all materials that are moved from the originating location to a new location for possible use. They include such items as:

- Contextual—the cultural, learning, and teaching traditions and the location of learners require consideration. In cultures where traditions of learning and teaching are more didactic, enquiry-based approaches to learning may not be a suitable fit. This is especially so at lower levels of study. Also important is the tone and simplicity of the language used.
- Disadvantaged learners—individuals from minority groups, as well as physically, aurally, and visually challenged individuals, may require special attention when materials are adapted for their purpose.
- Instructor skills—using the imported multimedia material skill of instructors has to be taken into account; provisions need to be made to train such teachers in new skills.
- Professional human assets—to enable local professionals to adapt the imported materials for local needs, all of the professional skills needed to create the original material need to be assembled and trained for purposes of adaptation.

Specific Factors

Certain factors specific to a lesson or a course have implications for repackaging imported multimedia materials for local use. These include:

- Suitability of purpose—materials produced for a particular group of learners in a specific learning location may not be a total fit in a different location for another group of learners; extensive adaptation may be necessary.
- Suitability of aims—aims of a learning experience vary from context to context. Context-sensitive materials may require major adaptation if the context of the new user is different.
- Relevance of learning objectives—objectives often are defined generally or specifically, and they focus on precise learning outcomes. If the objectives of an imported knowledge product are not sufficiently specific or relevant for the needs of a local course, revisions become mandatory.
- Match between syllabus and content—seldom does an imported multimedia package meet all of the needs of a local syllabus; amendments and supplementary materials may be necessary.
- Potential for adaptation—digitized materials do allow for manipulation of text, graphics, visuals, and audio; however, such adaptation requires skilled technicians, content experts, and resources.
- Promotion of active learning—the new technologies allow for extensive active learning opportunities; in selecting multimedia material from external sources, attention to this requirement is useful. As an alternative, such interactive learning can be incorporated during the process of adaptation.

Media Factors

Serious thought has to be given to the range of media technologies used in a course. Despite consortia such as the IMS Global Learning Consortium standards, there are still considerable differences in the range of technologies used to produce, distribute, and use multimedia materials. Some of the items requiring attention include:

- Range of media used—multimedia courseware clearly provides an interesting learning experience; therefore, when acquiring off-the-shelf materials, it is better to acquire material with a rich media mix than one without. However, overuse of media mix can be distracting. There is fine balance that needs to be achieved.
- Suitability of media used—it is also necessary to ensure a match between the hardware and the courseware. The rate of change taking place in both hardware systems and software programs can result in a mismatch that will be expensive to put right.
- Flexibility in the use of media components—imported multimedia may have media items that are not suitable or appropriate, or they may even be offensive to local

cultures. In such cases, it is helpful to local users to use some of the items and not others, if such use does not damage the integrity of the product. Such built-in flexibility will require clever instructional design.

> Options for media substitution—multimedia packages that allow for substitution of one component for another without losing the educational significance of the course is a lot more useful than one that does not have this facility.

CONCLUSION

This chapter began by examining the context within which policies and strategies for applying digital technologies to education and training must be considered. While there are enormous benefits to be gained in terms of quality, enrichment, and flexibility in using ICTs throughout formal educational systems, there is even greater value to be gained in using the technologies to increase access to millions of individuals who are currently outside the educational footprints of nations. A combination of the newer and older technologies has the potential to overcome the barriers of time, distance, and inadequate prior learning facing all those who wish to be informed, educated, and trained.

It is clear that ICTs offer opportunities not available previously to educators. Using tools such as e-mail; the Web; audio-, video-, computer–conferencing, both synchronously and asynchronously, a very rich interactive and individualized learning environment can be created that allows learners to dictate their pace of learning, place of learning, and the company they wish to keep (or not keep) while learning. While the ICT tools empower the learner, they need not take away from the role of the instructor. Instead, communities of learners and instructors come together for a common purpose and on a shared platform. These communities can encompass all levels and sectors of learning, from basic education to postgraduate studies, from teacher training to business studies, and from nonformal studies to language instruction. Only skills, knowledge, telecommunication infrastructure, fiscal resources, and policy support inhibit exploitation of this potential. Global experience already is beginning to demonstrate what is possible, how it is done, and what tools can be applied to the task. It is an exciting new world of learning and training.

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