Information and Communication Technologies in Education and Training in Asia and the Pacific

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PREFACE

In June 2001, the Asian Development Bank (ADB) published a new information and communications technology (ICT) strategy document entitled, *Toward E-Development in Asia and the Pacific: a Strategic Approach for Information and Communication Technology*. This document emphasizes the importance of information technology as a means to stimulate and foster development in Asia. ADB recognizes that the need to improve the intergenerational and international transfer of knowledge and skills to the more than one billion young people between 5 and 24 years of age in the Asia-Pacific region requires the adoption of the new learning technologies that are already widely used in developed countries.

> *Regional economies are rapidly embracing higher technology and provision of services… Globalization demands increased productivity, and the maintenance of international quality standards. The information technology revolution requires changes in the way knowledge is acquired and transmitted. Education can no longer be targeted mainly at children and youth; continuing education and lifelong learning are needed by everyone to acquire new knowledge and skills… ADB recognizes that its role must evolve…to incorporate greater provision of policy advice, technical expertise, and capacity building. Its role in the education sector must evolve simultaneously.*
>
> ADB Policy on Education

The second key document in addressing the issue of information technologies in development is ADB Policy on Education of August 2002.[1] This is a well thought-out and organized policy underpinning which enjoys strong support from the ADB senior management. It is here that ADB recognizes that its role must evolve from that of the traditional financier to incorporate greater involvement in policy

[1] See http://www.adb.org/Documents/Policies/Education/.

advice, in technical expertise, and in capacity building. Its very nature in the education sector must evolve as well. There is recognition of the growth of ICT and it's increasing importance in social and economic development, which has profound implications for education—both in how information technologies can be used to strengthen education, and how education can be more effectively used to promote the growth of ICTs in the region.

Without improved efficiencies in their present education delivery systems, it is unlikely that developing nations will be able to provide the additional human capital required to achieve economic self-sufficiency for all in the context of a highly competitive global economy that is increasingly based on the electronic transfer and manipulation of information. With little access to efficient learning and information systems, communal knowledge will not grow fast enough to counter obsolescence. Absorption of knowledge will be inadequate, as will the individual's means to act upon it for his or her improvement. Moreover, global knowledge is being produced and delivered at an accelerating pace, and in ever-increasing quantities.

ICTs applied to education offer huge potential to stimulate and realize the human capital inherent in the enormous number of young people in Asia and the Pacific. Yet, even in developed countries, it has proven difficult to measure precisely, and in a uniform way, the benefits of introducing ICTs—just as it was when books, radio, and even television were introduced. This is because the results are usually spread far beyond the specialized sector in which the investments are made, and there is normally a long lag between investment and dividends. For example, modernizing a small community banking network by retraining cashiers and officials, introducing computers with specialized software, and interconnecting the branches to headquarters, will shift that institution into a modern financial environment and allow it to interact effectively and efficiently with similar institutions, as well as provide up-to-date services to its clients. Such modernization is not an option for financial institutions; it is a matter of economic survival in a highly competitive world. However, the knowledge and skills gained by newly trained staff often prove far more beneficial for them outside the workplace; they benefit their personal lives—furthering their careers, improving their access to health, government, business, news, and other information, and strengthening their support of their family and their community.

Undertaking significant investments in education to enhance career opportunities, to successfully introduce the marginalized and the disadvantaged into a world that is meaningful for them, and to improve a nation's competitive stance, requires courage and determination from national leaders. The tangible benefits of improved education may not be realized until long after a politician's term of office expires, with the credit for gains most probably claimed by successors. In developed countries, the question is no longer whether ICT should be used to support education; it is more an issue of how much, what, where, and how. An official who is seen as not investing enough in enhancing education to ensure that the children of her or his voting constituency have a competitive edge is quickly turned out of office. An important shift has also taken place in definitions. The education sector now goes far beyond the concept of traditional students in a classroom, as it is still widely interpreted in the developing world. Mature adults in the active labor force are on a constant quest to improve their knowledge, and to try to keep up to date with developments in fields that can affect their way of work and their lifestyle. As discussed later in the vignette on the University of Phoenix,[2] for example, adult education is a very big business in constant expansion.

Many reasons are cited for the slow diffusion of ICT into schools in the less developed countries (LDCs) of Asia and the Pacific, including inadequate government funding, affordability, lack of infrastructure, and scarce qualified human resources. Very frequently, there are many more pressing domestic issues that are of immediate concern to elected officials. Improving access, quality, and delivery of education is not seen as critical in many countries where political instability, racial and religious tension, corruption, poverty, mismanagement, and other more strident and visible problems demand attention. Quite simply, the benefits of investing in quality education are often perceived as being of a very long-term nature, realized only when the learner enters the labor force.

While each of these factors has a varying influence in impeding the more widespread use of ICTs in schools throughout Asia and the Pacific, there are success stories that can guide those who wish to make a difference. This study will examine the current state of affairs

[2] See Chapter I, Distance and Mixed Mode Education.

for ICTs in education in Asia and the Pacific, and optimistically help to identify strategies for LDCs in their search for effective technologies to leverage efforts to educate their population.

More often than not, ICT-related activities in LDCs appear as pilot or demonstration projects funded by various donors. Even if projects in a country are frequently very similar to one another, they are usually implemented independently and often without coordination—-and without coordination with even with local government initiatives that should be complementary. For most LDCs, even where ICT projects are in place, they are seldom designed to fit in the national ICT policy framework or education strategy, nor do they serve as lessons to enhance future initiatives.

As related by Plato, Socrates was one of the first great educators to complain about the impact of new technology—his argument with the invention of the alphabet was that writing causes the memory to shrivel through lack of use, and hinders the internalization of information on the path to wisdom.

A significant proportion of the difficulties encountered in official sponsorship of ICT-related initiatives in developing countries are attitudinal in nature, involving teachers, administrators, officials, and politicians alike. The line of thought of many such people is that, if they were able to do without computers, multimedia materials, or management information systems in their schooldays, so can the current generation. Such resistance to change is not new.

The same arguments have dogged earlier technological advances in the representation of The Word. The printing press, the typewriter, and word processing have all, in their time, been subject to the misgivings of educators and others. Remember when the ballpoint pen was going to ruin writing skills?" [3]

This study examines among other things, current practices and attitudes in the use of ICTs in education in developed countries, and attempts to identify policies, strategies, and applications that could be implemented, with appropriate local adaptation, in ADB Developing Member Countries. Interlinks are provided, but over time may not remain active.

[3] Web Tools Newsletter 24 October 2003.

ABBREVIATIONS

ACOT	—	Apple Classrooms of Tomorrow
ADB	—	Asian Development Bank
ADSL	—	Asymmetric Digital Subscriber Line
AiTi	—	Authority for Info-communications Technology Industry
AITT	—	Acadia Institute for Teaching & Technology
AOLAPEC	—	America OnlineAsia-Pacific Economic Cooperation
APDIB	—	Asia-Pacific Development Information Programme
ASEAN	—	Association of Southeast Asian Nations
AT&T	—	American Telephone and Telegraph
BTTB	—	Bangladesh Telegraph and Telephone Board
CAIFA	—	Canadian Association of Insurance & Financial Advisors
CD	—	compact disc
CERNET	—	China Education and Research Network
CET	—	Certificate in Elementary Teaching
CETT	—	Certificate in Elementary Teacher Training
CFS	—	Computer for Schools
CIBT	—	Canadian Institute of Business & Technology Corporation
CIS	—	Commonwealth of Independent States
CLC	—	Community Learning Center (Myanmar)
CLICK	—	Center for Learning, Information, Communication, and Knowledge
CMI	—	College of the Marshall Islands
COL	—	Commonwealth of Learning
COM	—	College of Micronesia
CRC	—	Computer Resource Center
CSILE	—	Computer Supported Intentional Learning Environment
CSO	—	Central Statistics Office

DE	—	Distance Education
DEPP	—	Distance Education Partnership Program
DIT	—	Division of Information Technology
DL	—	Distance Learning
DNA	—	Deoxyribonucleic Acid
DOSDSL	—	Disk operating Systemdigital Subscriber line
EMB	—	Education and Manpower Bureau
EMIS	—	Education Management Information System
ERNET	—	Education and Research Network
FSM	—	Federated States of Micronesia
Gbits	—	Gigabits
GDLN	—	Global Development Learning Network
GDP	—	Gross Domestic Product
GHz	—	Gigahertz
GPA	—	Grade Point Average
GSM	—	Global System for Mobile communication
HRD	—	Human Resource Development
HTML	—	Hypertext Markup Language
IBM	—	International Business Machines Corporation
IATP	—	Internet Access and Training Program
ICT	—	Information and Communications Technology
IDA	—	Infocomm Development Authority of Singapore
IDCIEEE	—	International Data Corporation Institute of Electrical and Electronics Engineers
IL&FS ETS	—	Infrastructure Leasing and Financial Services (India), Education Technology Services
IMMEX	—	Interactive Multimedia Exercises
ISDNISM	—	Integrated Services Digital NetworkIndustrial, Scientific, and Medical
ISP	—	Internet service provider
ISTE	—	International Society for Technology in Education
ITECC	—	Information Technology and Electronic Commerce Council
ITU	—	International Telecommunications Union
ITU-D	—	International Telecommunications Union Development Bureau
JICS	—	Japan International Cooperation System
JTB	—	Jabatan Telekom Brunei

K-12	—	Kindergarten to Grade 12
LAN	—	Local Area Network
LDC	—	Less Developed Country
LOR Mbps	—	Learning Object Repositorymegabits per second
MIT	—	Massachusetts Institute of Technology
MoE	—	Ministry of Education
MoEYS	—	Ministry of Education, Youth, and Sports
mp2	—	Master Plan II (Singapore)
MSC	—	Multimedia Super Corridor
NAPITSE	—	national policy on Information Technology in School Education (Sri Lanka)
NTA	—	National Telecommunications Authority
NETS	—	National Educational Technology Standards
NGO	—	nongovernmental organization
NIA	—	Neo Internet Appliance
NICI	—	National Information and Communication Initiative Committee
NITA	—	National Information Technology Agenda
OLA	—	Open Learning Agency
OS	—	operating system
OUSL	—	Open University of Sri Lanka
PBX	—	Private Business eXchange
PC	—	personal computer
PITA	—	Pacific Islands Telecommunications Association
PLDT	—	Philippine Long Distance Telephone
PNG	—	Papua New Guinea
PNGEI	—	Papua New Guinea Education Institute
R&D	—	research and development
RDVA	—	Rural Development Volunteers Association
RM	—	ringgit
ROM	—	Read Only Memory
SAIFA	—	Schoolnet Academy of Insurance and Financial Advisors
SSACTA	—	State Student's Admission Commission technical assistance
TCI	—	Telecom Cook Islands
TEVT	—	Technical Education and Vocational Training
TSKL	—	Telekom Services Kiribati Limited

TTI	—	Teacher training institute
TV	—	television
UNDP	—	United Nations Development Programme
UNESCO	—	United Nations Educational, Scientific, and Cultural Organization
UK	—	United Kingdom
URL	—	universal resource locator
US	—	United States
USIA	—	United States Information Agency
USP	—	University of the South Pacific
VOIP	—	voice over Internet protocol
VSAT	—	very small aperture terminal
WBI	—	World Bank Institute
Wi-FI	—	wireless fidelity
WiLan	—	wireless local area network
WTO	—	World Trade Organization
www	—	World Wide Web

NOTE

In this report, "$" refers to US dollars

I

WHY INVEST IN INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN THE EDUCATION SECTOR?

Why invest in information and communications technologies (ICTs) when there are people who still live in absolute poverty and do not have enough to eat? This question is discomforting for everyone concerned with the intersecting issues of ICT and development.

If we can't feed, clothe and cure everyone, why should we invest in ICTs? Why not put all the money into the basics? What will a computer do for someone who is hungry, sick, or illiterate? Perhaps little today, but the benefits tomorrow are potentially enormous. Additionally, we do not want anyone to develop permanent dependencies on foreign assistance, so it is better to teach people how to fend for themselves. Further, countries—down to the village level—-simply cannot afford to be marginalized by not participating in the knowledge world. A country that elects to let the digital world pass by in order to respond to the more pressing internal needs runs the risk of being left further and further out of the new global market and its economic and social opportunities. One of the most devastating outcomes of this laissez-faire approach is the loss of a country's most promising young people to better education and employment opportunities elsewhere, possibly to never return and help their own country in its evolution.

Countries able to harness the benefits of ICT have access to global markets, which spurs GDP growth. They have greater access to educational opportunities and up-to-the minute medical information,

which improves standards of living. And citizens in these countries have a means of monitoring their government to ensure protection of human rights. These statements may seem wishful for countries that have little to export but a limited range of natural resources. Yet, reliance on trade in natural resources must be replaced by movement toward the knowledge economy. Japan, Hong Kong, China, and the Republic of Korea have limited natural resources compared many other countries, yet they are prosperous because of the quality of their human capital and their use of information. Perhaps such countries as Kiribati, Bhutan, and Samoa may not become equals to Japan in the short term, but they are certainly capable of moving up the value chain with a little help.

An effective strategy incorporates a balance of investment in basic needs, while at the same time facilitating ICTs. By contributing to both the immediate needs of the country, such as health, education, and security, and by creating an enabling environment that welcomes the use of ICTs through the provision of infrastructure and stimulating and competitive policies, nations can meet the needs of their citizens while participating in developments on the global information highway.

When investment in ICTs is discussed, particularly in education, the normal response is that it is the responsibility of government to provide education as a basic and essential service. With a good policy and regulatory framework, the private sector will address profitable segments of the education sector. However, the sheer volume and complexity of knowledge, available in ever-increasing waves, leaves the traditional approach to teaching unable to cope. Today, as discussed in the following chapter of this paper, the teacher cannot be expected to be fully knowledgeable in even his or her own area specialization. The role of teachers is changing to that of guide, mentor, motivator, and team leader. Significant investments must support this shift and train new cohorts of educators who will be more generalists and resource persons than lecturers.

With the shortage of qualified teachers in developing nations, the learner must take more responsibility for his or her education. To empower the learner and to help the teacher or tutor to support the student, ICTs are the ideal intermediaries to convey relevant knowledge in a timely and captivating fashion regardless of location or time of day. Television, radio, music, graphic arts and dance are universal media in Asia and the Pacific, but books far less so. In many

countries there is a decided aversion to reading. In an ICT-enabled environment, learners can enjoy captivating presentations of relevant knowledge delivered in formats tailored to their personal attributes, enhanced by new ways of facilitating absorption of information through the involvement of the learner in self-testing and seamless iteration with feedback. As a result, the learner feels there are practical applications for this knowledge, and that it can be used to their benefit. Investments in human capacity building for educational institutions, for administrators, for teachers, and for support staff will inevitably have repercussions in other areas of an economy and society as expanded human and material infrastructure is shared with other interests. The newly trained will seek to make use of their new capabilities and knowledge outside of the learning environment.

In the developed world, education and research—which go hand in hand—are often the major locomotives that pave the way for expanded ICT access and network capacity, and increased performance and computing power. Consider where Arpanet has led, with its objective of developing "the best academic computer centers."[1] As the precursor to the Internet, it has generated a global revolution that has forever changed the way things are done in every sector, and in every country. The consensus among experts, whether from developed nations or not, "…is not whether to respond to the challenges brought about by the revolution in ICT, but how to respond and how to ensure that the process becomes truly global and everyone shares the benefits." [2]

[1] See http://www.dei.isep.ipp.pt/docs/arpa.html.

[2] Report of the Meeting of the High-Level Panel of Experts on Information and Communication Technology, New York, 17-20 April 2000.

II

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

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

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

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

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

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

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

A. Teacher and Student Attitudes and Behavior

Teachers

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

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

Best Practice: The Connected Campus

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

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

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

(continued)

[a] For more information, see: http://www.acadiau.ca/advantage/aboutaa/whatisaa.html.

Best Practice: The Connected Campus (continued)

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

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

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

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

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

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

Students

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

[3] See Yildrim (2000).
[4] See National Education Association (2000).
[5] See Lui, Macmillan, and Timmons (1999).
[6] See Kulik (1994).
[7] See the discussion on AutoSkill in section on Assessment and Monitoring in this chapters.
[8] See Mayer and Coleman (2000).

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

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

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

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

[9] See Diaz (2002), pp. 1—2.
[10] *Daily Herald.* 2004. New Acceptance of On Line Learning Fuels Explosion. 21 March.
[11] See Bolam and Dodgson (2003) and Allred (2003).

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

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

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

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

[12] See Bates (2000), p. 5.
[13] See Oblinger et al (2001), and Jones and Pritchard (2000).

B. Learning Materials

Traditionally, students have learned about the world from teachers in classrooms and labs and through books. Now technology allows them to obtain—at their own initiative—in-depth information about an unprecedented array of subjects and cultures electronically by, for example, corresponding with their global peers via their mobile phones ("texting") and personal computers. Microsoft Encarta[14] and the like have proven outstanding sources of easily accessible, understandable, and often fascinating reference materials that are browsed and absorbed eagerly. For many students, acquiring knowledge in this manner is more like fun than study.

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

C. Education Administration

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

[14] See http://encarta.msm.com/.
[15] See Paulson (2002), p. 124.
[16] See Paulson (2002), p. 126.
[17] See Miller (2001) and Williams (2003).

Best Practice: Modularized Course Objects

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

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

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

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

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

Peter Donkers 2004[a]

[a] Peter Donkers is a former executive with OLA and currently a Senior Associate of Caelis International.

organizer, grader, mentor, role model, counselor, coach, supervisor, problem solver, and liaison." [18]

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

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

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

[18] See Riffee (2003), p. 1; Roberson, et al (2002); and Scagnoli (2001).
[19] See Penn State University Strategic Plan (1998), p. 4.
[20] See National Education Association (1998).
[21] See Penn State University Strategic Plan (1998).

D. Education Management Information Systems

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

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

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

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

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

Tutorials

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

Today, a significant amount of audio-visual product not initially designed for formal education has proved to be excellent instructional material and is produced in a medium well-suited to ICT and DE. Examples include the various David Suzuki [23] television series, such as "The Nature of Things" (Canadian Broadcasting Company), and Discovery Channel and History Channel documentaries. A teacher using traditional textbooks and blackboard would hardly expect a class to become knowledgeable in tectonic plate physics in 60 minutes. Yet Dr. Suzuki, with his non-threatening approach and a compelling combination of exotic film locations, sense of adventure, and supplementary resources—such as video clips and interviews with

[22] Dasher-Alston and Patton (1998), p.14.
[23] See http://www.davidsuzuki.org/.

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

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

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

[24] See http://www.leboe-grice.com/.
[25] CD = compact disc.

Global Links

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

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

[26] See http://www.cibt.edu.
[27] See http://www.wintu.edu.
[28] Source: CIBT, October 1, 2003.

Earning through Learning

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

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

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

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

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

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

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

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

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

[32] See http://www.schoolnetindia.com/avl/saifa.asp.

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

Sector/ Geographical	Public	Non-Profit/ NGOs	Private / Corporate
International	World Bank UNESCO European Commission UNDP InterAmerican Development Bank	COL International Extension College Aga Khan Foundation	WorldSpace Foundation, AT&TBritish Telecom, BBC World, Cable & Wireless, Microsoft, General Motors University of Phoenix Sun Life Insurance
National	Government departments	National Extension College (UK)	Schoolnet (India), IBM Starbucks, McDonald's
State/ Regional	State Open Universities (e.g., PRC, India) OLA (British Colombia, Canada)	State Resource Centres for Adult Education (India) Scottish University for Industry	Small enterprises providing training Employers
Local	Local schools and training centers Employment Commissions	USP Women's groups	Small enterprises Employers City of Vancouver
Individuals	Agricultural workers Unemployed Refugees	Local credit unions Volunteer members Arthritis Foundation CDC Atlanta	Employees CGA (Canada) CAIFA

AT&T = American Telephone and Telegraph, BBC = British Broadcasting Corporation, CAIFA = Canadian Association of Insurance & Financial Advisors, CDC = Center for Disease Control, CGA = Canadian Government Association, COL = Commonwealth of Learning, IBM = International Business Machines Corporation, NGO = nongovernment organization, OLA = Open Learning Agency, PRC = People's Republic of China, UK = United Kingdom, UNDP = United Nations Development Programme, UNESCO = United Nations Educational, Scientific, and Cultural Organization , USP = University of the South Pacific. Source: Adapted from Judith Calder, COL.

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

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

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

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

F. Distance and Mixed Mode Education

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

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

[33] See Education Guardian Weekly (2001).

[34] See http://www.agb.org/.

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

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

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

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

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

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

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

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

Phoenix Rises

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

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

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

Massachusetts Institute of Technology

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

(continued)

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

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

Cappella University

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

[a] See: http://www.uopxonline.com/
[b] See http://www.capellauniversity.edu

The four items judged to be of least importance were:

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

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

[37] See de Alva (2000), p. 32.
[38] See Johnstone et al. (2002), Pond (2003), West (1999), and Dubois (1996).

G. The Current Status of Distance Learning

Prognosticators seem to be having a field day estimating the current and potential size of online learning, and their figures vary wildly. In the US, Booz, Allen, Hamilton forecast this market would be worth $12 to 14 billion in 2004.[39] International Data Corporation (IDC) claims the corporate e-learning market, which was roughly $5.2 billion in 2001, is expected to exceed $23 billion by 2006, a worldwide increase of more than 35%.[40] By 2005, revenues in the US for virtual-classroom software and services are expected to exceed $1 billion, according to Lewis Ward, senior research analyst for San Francisco-based Collaborative Strategies.

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

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

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[39] See French, Marlene. *Re-learning E-Learning.* Booz Allen Hamilton.
[40] See Kaplan, Ari. 2004. *The Worldwide classroom.* Available: http://www.computeruser.com.
[41] See http://www.worldcampus.psu.edu/pub/index.shtml.
[42] See http://www.arizonaregentsuniversity.org/.
[43] See http://www.cvc.edu/.

As more and more knowledge becomes available online, a great deal of printed material is obsolescent, if not obsolete. This is especially disquieting for post-secondary institutions in developing countries, which are attempting to ensure that their students achieve equivalent outcomes and are able to compete with graduates in the developed world. This is particularly true in rapidly evolving disciplines such as pharmacy, medicine, optometry, library sciences, engineering, agriculture, computer technology, nursing, etc. Visits by the author to a number of post-secondary institutions in Asia and the Pacific during 2001—2002 revealed freshly printed copies of DOS[44] manuals being readied for distribution to computer science students. There were no plans to modernize the material since teachers were comfortable with it, and there were few if any opportunities for them to update their own knowledge. A brief review of printed learning materials in many other sectors demonstrated that the problem was not unique to technology courses, but was widespread across departments and faculties.

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

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

[44] Disk operating system (DOS) has been obsolete for at least 10 years.
[45] See Gallagher (2003).

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

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

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

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

CNN.COM/Education 22 July, 2003

[46] See Oblinger (2000).
[47] See Global Distance EducationNet (2000).

H. Assessment and Monitoring

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[49] See Gardner (1992).

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

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

Case Study: Making the Most out of Assessments[50]

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

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

[50] 1998 Editorial Projects in Education.

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

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

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

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

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

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

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

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

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

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

Assessment programs like IMMEX also raise the all-important question of whether students learn more, or differently, when they use computers. Some educational researchers believe that traditional forms of assessment can't adequately measure student achievement on performance tasks like multimedia presentations. Research on computer-based assessments—very little of which has been conducted so far—could begin to address whether they more accurately reflect students' abilities. The students say it's faster and easier to run a problem on the computer instead of having to shuffle through papers for a traditional exercise, and they seem to appreciate the intellectual challenge of IMMEX. As Tennille Hyde, age15, said, "It puts your brain to work."

Research Reports and Studies

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

a. Kulik's Meta-Analysis Study

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

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

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

b. Sivin-Kachala's Review of the Research

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

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

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

c. The Apple Classrooms of Tomorrow

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

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

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

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

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

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

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

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

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

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

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

f. The Learning and Epistemology Group at MIT

Seymour Papert,[51] Michael Resnick, Yasmin Kafai, and Idit Harel[52] have employed learning by design principles to education technology by having students become creators and designers of educational software. These researchers use the computer as the machine to be acted upon and students as the actors. Children thus learn through design activities by programming computers to create applications that other children use and learn from.

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

[51] See I. Harel and S. Papert (1991).
[52] See I. Harel (1990).

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

g. The National Educational Technology Standards

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

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

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

[53] See http://cnets.iste.org/.

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

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

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

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

I. Tutors and Support

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

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

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

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

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

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

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

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

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

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

Challenges Facing Students

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

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

Responsibilities of Students

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

Tutors as Learners

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

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

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

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

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

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

[54] See http://www.iitt.org.uk/c-onltutor.htm.

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

Working in Teams

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

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

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

Instruments to Support Tutoring

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

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

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

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

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

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

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

Assessment Tools

The most commonly used assessment tools are:

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

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

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

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

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

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

A Quantitative Approach to Measuring Outcomes

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

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

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

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

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

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

J. Costs

Hardware and Software

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

[56] See http://www.autoskill.com/results/.

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

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

New kinds of appliances and servers designed for the education market are emerging. One set of such instruments, tentatively dubbed the NIA[58] PC and the NIA Server, has price targets of $300 for the PC and $750 for a full server. The system is billed as a hassle-free, no-nonsense PC-Server combination. It offers a powerful Linux open source operating system, Apache Web Server, MYSQL, Mozilla and the WeTiki Web engine. The operating system and applications are written into ROM,[59] thus no continual upgrades are required, and there is no risk of viruses or Trojan infection, or from hacking or software corruption. The Web server is ready to use out of the box. It comes with some of the most powerful content management systems known and it is easy enough to use that the teacher or an assigned helper does not have to call in a technical expert.

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

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

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

[58] NIA for Neo Internet Appliance.
[59] ROM = Read Only Memory.

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

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

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

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

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

[60] See: http://bates.cstudies.ubc.ca/.

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

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

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

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

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

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

Human Resource Development

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

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

Building Capacity in a Developing Country

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

International Instructors, 2 for 30 days at $600 including course preparation and travel time: $600x60	=	$36,000
Travel: $5,000 travel x 2	=	10,000
Accommodations: $125 per day for 20 days x 2	=	5,000
Software and materials for 30 clients	=	10,000
Total	=	**$61,000**

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

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

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

K. Conclusions

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

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

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

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

III

THE STATUS OF ICT IN EDUCATION AND TRAINING IN ASIA AND THE PACIFIC

A. The Enabling Environment

The quality of the enabling environment is arguably the single most important factor in stimulating the use of information technologies on a broad scale in any country. If a nation adopts stimulating and open telecommunications and IT sector policies that are supported by regulatory mechanisms that encourage fair competition and sustain the provision of quality services equitably, public and private investment will naturally flow to the most promising applications. Such investments will also have a strong tendency to create a ripple effect in other economic sectors. For example, setting up a financial management system that interconnects government offices in the capital with those in provinces provides a network that should also be available for other purposes. Email, emergency communications, economic and business information, news, health, and other government services can easily "piggyback" on the core financial application, and enhance its viability.

Thus, a sound and energetic enabling environment implies:

- Political commitment at the highest level;
- An institutional framework that will map broad policy guidelines;

- Implementation mechanisms that will ensure a level playing field for competition;
- Strategies to support special funding to encourage the extension of communications services to schools, libraries, hospitals, community centers, and other public facilities where economic viability may not be achievable in the short term;
- Transparency in public operations;
- Balanced rates for persons and business;
- Affordable access for remote and rural areas; and
- Standards of quality in services.

Sector Policies

Just as there must be a good, well-planned road network to support the transport of persons and goods, creative policies and strategies for ICT in education should rest upon an underlying national platform for ICT as a whole, linking resources across sectors. Otherwise, sector-specific policies will "float" in a vacuum, and most often will not be sustainable. The exception to this rule is strong pilot projects that can expand from the ground up and stimulate the adoption of appropriate policies as they grow in impact and scope.

In most countries, ICTs will inevitably permeate every facet of personal, social, and economic life even without what is now commonly called an "ICT roadmap"—a methodical, all-embracing, and articulated policy and framework for implementation. In the absence of a coherent national policy framework, however, efforts and results tend to be haphazard and spotty, and may not lend themselves to replication; nor will they tend to stimulate the sharing of human and material infrastructure. In such cases, each initiative often has to be constructed from the ground up, with no collective growth of expertise, no common progress on the learning curve, and few national lessons learned as individual plans are implemented.

a. Common Objectives of ICT Policies

In its 1999 Economic and Social Survey of Asia and the Pacific, the United Nations Economic and Social Commission for Asia and the Pacific listed some basic goals that ICT policies often try to meet:

- Improve a nation's competitiveness and productivity.
- Enhance and diffuse the benefits resulting from successful implementation of information technology across sectors.
- Help people and organizations adapt to new or changed circumstances, and provide tools and models to respond rationally to challenges and new opportunities presented by ICTs.
- Provide effective and efficient information and communication facilities, services, and management at a reasonable or diminishing costs.
- Constantly reassess the need to perform certain tasks that have been done without question for years, and find better ways of doing those things that really need to be done.
- Improve the quality, accuracy, and timeliness of services and products.
- Encourage innovations in technology development, use of technology, and general work flows.
- Promote information sharing, transparency, and accountability, and reducing bureaucracy within and between organizations and in their interface with the public at large.
- Identify priority areas where the introduction of ICT will have the greatest positive impact on programs, services, and clients.
- Provide citizens with a chance to access and contribute information using formats that are user friendly—i.e. easy for them to digest and to operate according to their preferences.
- Attain a specified minimum level of information technology resources for educational institutions and government agencies.

- Encourage and support lifelong learning.
- Provide individuals and organizations with a minimum level of ICT knowledge, and the wherewithal to keep it up to date.
- Demystify and facilitate the ICT environment, and encouraging the availability of appropriate applications at the deepest levels of poverty, segregation, and isolation.
- Empower the poor and marginalized to get easy access to accurate information relevant to their own situation in a timely fashion.
- Allow people, communities, regions, and interest groups to communicate and exchange information freely, at affordable cost, and with equitable access.
- Reduce costs, and improve efficiency, effectiveness, and the flow of revenue.
- Help people and institutions understand information technology, its development, and its cross-disciplinary impact.
- Encourage technology and content development partnerships with other countries.
- Enhance national security.

b. Common ICT Policy Elements

National ICT policies commonly address the concerns listed below.

- Development of legislation and policies for diffusion of information technology, adoption of standards, development of ICT industries, trade policies for ICT-related goods and services (e.g. WTO), pricing and taxation of electronic services, protection of intellectual property, privacy of personal data, safeguarding and promoting cultural and linguistic diversity, and protection against illegal and harmful content.

- Development of ICT infrastructure, including hard and soft infrastructure expansion, modernization, protection, and development; development of technical standards; interoperability of information systems and applications; enhancement and dissemination of public services; cost savings in service delivery, purchasing, communication, etc.; and electronic commerce and secure transactions.
- Development of skills, including ICT education and training, asynchronous learning, research and development, training for call centers and outsourcing, and multimedia illustration of specific applications.
- Institutional and regulatory structures, and institutional development and coordination issues that address national ICT development planning and coordination; international interface and cooperation; affordable and equitable access to appliances and applications; access to modern infrastructure; access to current and accurate information; monitoring ICT progress, results, and costs; monitoring the use of ICT and sharing results; and measurement of the impact of ICT.

National ICT policies may also deal with specific issues, such as the Y2K problem, Open Source Software, and standardization of hardware and software. Institutional or organizational-level policies cover similar issues as above but with an approach more focused on their particular situation, such as use of ICT assets for personal benefit, anti-pornography or gender sensitivity issues, privacy, and corporate and organizational intellectual property.

While international cooperation and exchange of experience are advantageous in most ICT areas, certain national policies are contingent on it. For example, standardization of telecommunication protocols, international interconnection of networks and traffic management, international settlement rates, radio frequency spectrum management, intellectual property, and setting rules for the administration of Internet domain names, cannot be accomplished without international cooperation.

Institutional Framework

By mid-2003, some 123 countries worldwide had recognized the importance of establishing a regulatory authority to foster competition in the ICT sector. More than half of the countries in the world had fully or partially privatized their incumbent telecommunication operators. A further 24% of countries had, although retaining state-owned incumbents, introduced private-sector participation through licensing of new fixed, international, or mobile operators.

Less than one-fifth of the countries in the world had no form of private participation in their telecommunication sector.[61] Even if the thrust of public policy and regulation clearly is to stimulate competition in order to reduce prices, expand coverage to more remote and rural areas, improve service, and offer a much wider spectrum of enhanced services, incumbent telephone operators will often find means of delaying or impeding the launch of new entrants to what has traditionally been their protected marketplace.

In Sri Lanka, for instance, the government authorized several new operators to provide competitive international telephone and Internet services. But several months after these decisions, the traditional operator had not yet found it convenient to interconnect the new firms to its network, or to provide additional access ports. In the Fiji Islands, the domestic operator will not allow clients to connect directly to the international operator, which has an excess of bandwidth it must sell to be economically viable. The domestic telephone company insists that all traffic be routed through its circuits. This has the effect of dramatically increasing costs for users and, conversely, reducing performance due to the older domestic network and switching technologies. Yet, customers are clamoring for better international rates and improved domestic and international services.

Some creative institutions manage to escape the confinement of the local telephone company's network. An interesting case in point is the University of the South Pacific (USP), which has established its own satellite communications network (USPNet) from its headquarters in Fiji Islands to remote campuses across several island countries in the Pacific utilizing VSAT[62] technology.[63] It is thus

[61] International Telecommunications Union. 2003. *Trends in Telecommunication Reform.* Geneva.
[62] VSAT = very small aperture terminal.
[63] See http://www.usp.ac.fj/its/sections/uspnet/.

effectively bypassing the traditional telephone operators, some of which are reluctant to see the USP extend its services to its teachers and learners through dial-up connections on the telephone company's circuits.

Although in common use in North America for several years, low-cost, high performance wireless technologies that are relatively new to Asia—such as Wireless Local Area Network (WiLan), which conforms to the Institute of IEEE[64] 802.11 standard—may render traditional telephone company resistance futile in the very near future. Discussion of Indonesia below relates some creative uses consumers in the learning environment are making of wireless technologies when the telephone company is not readily disposed to provide efficient and competitively-priced services.

Infrastructure and Applications

Governments in some developing countries may have difficulty in coming to grips with the rationale for investing horizontally in ICTs. They will often approve specific vertical projects, such as a network to support a financial management system, or online access for customs and taxation. Such investments have traditionally been made in sectors such as finance, treasury, and transport, with the result that physical and intellectual assets, such as buildings, databases, and software of one government department often are not available to another. This happens even where there is an obvious need, and the marginal cost of sharing is far lower than acquisition of a new asset by the have-not organization. Some absurd situations have been observed, such as a department that would rather keep a building severely underutilized than have another department share its facility—the obvious concern being that the newcomer may one day take over the asset if its staff become more numerous. The same reasoning may apply to IT resources—even though sharing a network, applications software, and expertise between departments, and ultimately, sharing resources with the private sector, makes more economic and technical sense.

ICTs are very similar to road networks, in that facilities resulting from investment in such things as government administration, health, financial management, and education are available to users from all sectors. Thus,

[64] Institute of Electrical and Electronics Engineers (IEEE) is a non-profit, technical professional association of more than 360,000 individual members in approximately 175 countries.

a national backbone communications network established to support government financial management—such as one linking the Ministry of Finance in the capital to centers in the provinces and districts—constitutes an electronic highway that should also be available to convey information to and from hospitals, clinics, schools, and local government.

The Global Context

> *Improving school governance by increasing community involvement offers an excellent opportunity to inculcate appropriate skills and attitudes in the community as a whole. Education empowers, and a major manifestation of empowerment is the demand for better governance. Perhaps the single most important thing that can be done to promote good governance is to facilitate access to information and knowledge since this forms the basis of decision- making and concerned action.*
>
> ADB's Policy on Education

Over the past few years, the bulk of the world's timely and useful information has migrated to the Internet. Every newspaper and magazine worth mentioning has an Internet edition which is often updated every hour if not more often. These sites, such as Economist.com and the Wall Street Journal (wsj.com), often get many times more electronic visitors than subscribers to their print edition. Most major tertiary educational institutions in the first world are moving to online journals, and they have stated their intent to migrate to online libraries for new content in the near future.[65] Personal and business information is exchanged through email that, traveling at the speed of light, can get from Kathmandu to Vancouver, with copies to Manila, Washington, and Abidjan, in a few seconds. Normal mail to or from the Philippines, Nepal, Pakistan, and many other Asian countries may have a 50/50 chance of reaching its destination several weeks later. In the developed world, most professional and business exchanges between individuals and colleagues take place over the Internet.

[65] Example, University of British Colombia at http://www.library.ubc.ca/collections/transition_online/.

The growth in Web communities, with such specialized and eclectic interests as breeding of Schnauzers, works by Gide, maintaining antique Phaetons, or rare book collecting, is phenomenal. These communities are inevitably the channel of choice to inform people with similar interests across the globe, or when searching for goods or services. In North America, it is standard practice to use the Internet to look up prices and availability of goods or services, to browse for a home or auto, to find best deals for insurance or financial services, and to evaluate educational institutions and their offerings.

A learner will most often look on the Internet for an easily digested explanation for such topics as "tectonic plate shift," rather than browse through an encyclopedia or textbook. On the Internet, it is much faster to find, it is presented in color—often with video and audio, and it will often offer a degree of interactivity and convenient links to related information. Print editions of the prestigious Encyclopedia Britannica or the Grolier can't find buyers at $100 at garage sales, even when they were purchased a few years earlier for over $2,000. What then to make of the poor child in an Indian, Pakistani, or Philippine classroom who must share a 5-year-old torn and ragged book with several classmates? Or the farmer who has invested all his savings to put in a corn crop, without knowing that corn futures in his country had dropped 30% in the past week?

The Internet has grown at an astounding pace. At the beginning of 2003, there were an estimated 580 million users around the world. Practically every country in the world is now online. In some developed markets, more than half of the adult population has Internet access. The same cannot yet be said for developing countries, where there are still problems with connectivity and affordability. In addition, lack of computer skills is a major barrier to Internet connectivity. A suite of new wireless technologies, however, holds much promise for improved Internet access in the developing world. Up to 2003, it was generally accepted that Internet access required local telephone line access for dial-up connection at between 14.4 to about 42 kilobits[66] to a phone company's central office (CO), which in

[66] Although a 56 kbps modem could theoretically deliver 56,000 bits per second, it would have to be connected to a fiber cable (loss free) very close to the telephone company's CO. A copper line suffers loss from connections, interference, varying quality of outdoor and in-building wiring, the CO's line card, etc. all cause some signal degradation. Actual throughput of a dial up connection is typically 1/10th of its reported speed. For instance, a 28.8 kbps connection could theoretically deliver up to 2,880 bits per second.

turn plugged in to a Point of Presence to the Internet. The wide adoption of wireless communications in the Industrial Scientific and Medical (ISM) bands have caused a major shift in planning for future networks.

The new wireless networks (Wi-Fi, or Wireless Fidelity) utilize radio technologies that adhere to the IEEE 802.11 standard[67] to provide secure, reliable, fast wireless connectivity. A Wi-Fi network can be used to connect computers to each other, to the Internet, and to wired networks across communities. Wi-Fi networks operate in the unlicensed 2.4 and 5 GHz radio bands, with an 11 megabits per second (Mbps) (802.11b) or 54 Mbps (802.11g) data rate, so they can provide real-world performance similar to the basic Ethernet networks used in government facilities, private offices, universities, and other organizations.

Wi-Fi networks are also found in busy public places like coffee shops, hotels, airport lounges, and other locations where large crowds gather. This may be the fastest-growing segment of Wi-Fi service, as more and more travelers and mobile professionals clamor for fast and secure Internet access wherever they are. Soon, Wi-Fi networks will be found in urban areas providing coverage throughout the central city, or even lining major highways, enabling travelers access anywhere they can pull over and stop.

In Indonesia, facing a severe lack of connectivity and line quality problems with the traditional telephone carriers, groups of savvy technicians and educators are building their own Wi-Fi networks to connect homes and schools at minimal cost. From a single reliable Internet connection, they extend by line of sight using homemade antennas to share high-speed access. According to Dr. Onno Purbo, a well known Indonesian writer and technical guru affiliated with the Technical University of Bandung, the easiest way to extend services affordably is the wireless LAN running at 2.4GHz. Anyone with a reasonable knowledge of Linux can easily integrate a low-cost gateway/router for about $150 per unit to connect a LAN or a community to the Internet at 11Mbps, using external antennas with sufficient gain to reach an access point that can be up to 12 kilometers away. Building a low-cost homemade antenna is not that difficult, says Dr. Purbo. At a

[67] Institute of Electrical and Electronics Engineers, New York, www.ieee.org. A membership organization that includes engineers, scientists and students in electronics and allied fields. It has more than 300,000 members and is involved with setting standards for computers and communications.

cost of approximately $5 to $10, a 90 millimeter diameter tin can with a length of 215 millimeters can be easily used as a 2.4GHz antenna, and has proven quite satisfactory for 3 to 4 kilometer distances.

Bangladesh is another country using smart adaptive innovations. There, local Internet service providers (ISPs) are using customized LAN equipment to deliver their services. After a period of trial and error, the Bangladeshi ICT professionals have begun local manufacture of robust wireless LAN equipment for outdoor installation that enables subscribers without telephone lines to get on line.

Asia and the Pacific

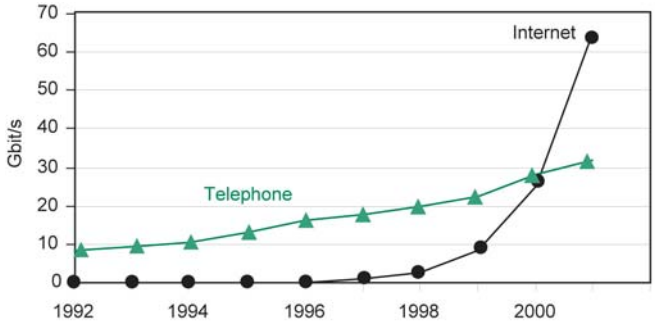
Since 2000, all of the world's less developed countries (LDCs) have been able to access the Internet through a direct connection. However, the number of Internet users in those countries remains extremely modest. In 2000, there were only about 580,000 estimated Internet users in LDCs, representing less than 1% of their aggregrate population and 0.16% of global Internet users. The growth rate of Internet users in the LDCs is also relatively low, falling from 234% in 1999 to only 56% in 2000, not much higher than the global growth rate—which has been assessed at 49%. Globally, the networks are relatively efficient and affordable. The slow growth in LDCs thus suggests the existence of certain bottlenecks that are affecting development at the country level, notably, (i) weak and very localized infrastructure, (ii) an unfavorable regulatory climate, (iii) relatively high pricing in the local market, and (iv) uncompetitive market structures.

These bottlenecks are barriers that, when combined, form a log jam that cannot be defeated without significant government intervention on each one of the barriers. The question most often posed is: where to start? It may be difficult to modify the structure of demand or supply for services. Issues of regulatory policy are a matter of national sovereignty, and good examples and advice may not necessarily be followed due to conflicts of interest, especially where government is still a major shareholder in the local carrier. However, it is widely recognized that all the elements are interconnected, and that it may be sufficient to impact one of them successfully in order to influence the evolution of the others.[68]

[68] Adapted from Claudia Sarrocco, 2002. International Telecommunications Union, Strategy and Policy Unit.

According to the International Telecommunications Union (ITU),[69] the Asia-Pacific Region's connective capacity has increased dramatically—by a factor of more than 10—since early 2000, when it had less than 10 Gigabits (Gbits)[70] per second in international capacity (Figure 1). As of mid- 2003, it had over 70 Gbits per second to carry Internet services, surpassing the region's traditional telephony carriage capacity, which stood at around 30 Gbits per second. Even so, the number of telephone subscribers has increased faster than in any other region of the globe.

Figure 1
Asia-Pacific International Communications Capacity



Recently, the more developed nations in the Asia-Pacific region are leading the world in terms of increasing their capacity to access the Internet. While North American consumers are just now migrating in larger numbers from dial-up access to broadband, "always-on," connections due to highly competitive prices, dramatic increases in information available on the internet, and ever more businesses offering goods and services online, consumers in the Republic of

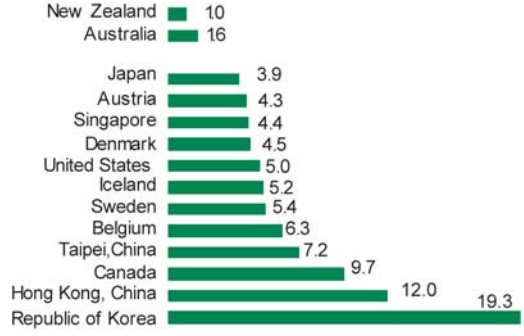
[69] ITU News Magazine.
[70] Giga = 1,000 million bits per second.

Korea, Hong Kong, China and Taipei,China have been eagerly signing up for broadband since 2000 (Figure 2).

However, before broadband becomes widely available in the Asia-Pacific region, there are issues of economics and marketing that must be addressed. Many telephone carriers are still focused on maximizing revenue from the most densely-populated areas. The extension of communications to rural and remote areas, and the offering of true enhanced services, are often forgotten in their pricing strategy, and Internet access seems too often to be a neglected offering in LDCs.

North American carriers have long ago concluded that ordinary voice carriage as a stand-alone product is a losing proposition; enhanced services that can be piggybacked on the voice customer's basic service are what make the margin worthwhile. Since such enhanced capabilities as voice mail, call forwarding, caller id, medic-alert, burglar alarms, wake up, follow me, etc. are already built into most modern central office switching systems, it is puzzling that carriers in developing countries do not make the most of these options. Similarly, most Asian carriers are still clinging to Integrated Services Digital Network (ISDN)—a technology long ago discarded in the Americas to offer broadband.

Figure 2
Economies by Broadband Penetration, June 2002



a. Anomalies: Cost Vs. Connectivity

The costs of communications, given a sufficient capacity "pipe" into a country, are often irrational in the developing world. Taking into consideration such input variables as labor costs, municipal restrictions and procedures, rights of way, and inter-agency coordination, and the fact of prices of raw materials—such as copper or fiber optic lines—being the same everywhere, why would a leased 64 kb line cost $5,000 a month in the Fiji Islands, or Manila, and more elsewhere, while the same circuit may cost $450 or less in New York, Portland, or Vancouver, where municipal, utility right of way, and labor costs are many times higher?

This conundrum affects costs as well as performance. For instance, an "always on," reliable Asymmetric Digital Subscriber Line (ADSL) connection at 1.5 megabits in Vancouver is offered by competing ISPs Telus, Shaw, or Novus at the equivalent of less than $24 a month. In Manila, with a similar infrastructure capability, ePLDT, an affiliate of Philippine Long Distance Telephone Company (PLDT), offers an Internet connection that can deliver up to 128 kilobits downstream (towards the subscriber), and up to 64Kbps upstream, for an installation fee equivalent to $40 and a monthly fee equivalent to $50.[71] This connection capacity is less than 1/10th that of real ADSL in North America, at more than double the cost, and is far less reliable since service interruptions in Manila are frequent, with no refunds for time out.

If we use a teacher's salary as a proxy for affordability, for a senior Filipino teacher earning about 15,000 pesos a month, this connection would represent 17% of his or her gross monthly income. If we were to adjust the price for North American ADSL connection speed—since the Philippine infrastructure is technically capable of delivering it—by simply scaling up price on a linear basis, we arrive at an equivalent cost of say 25,000 pesos per month, or 166% of the teacher's monthly income. A North American teacher earns about $5,000 a month, thus the real high-capacity ADSL connection will cost her or him 0.5% of monthly salary. This comparison applies to most developing countries in the Asia-Pacific region. In many cases, the obvious problems with performance and affordability are even more striking (Table 2).

[71] On 10 November 2003, at http://www.pldtdsl.com/products/packages.html.

Table 2: Type and Capacity of Internet Connection

Type of Connection	Capacity of Connection	Comparison
Dial-up (or DS0)	64 kilobits per second	
ISDN	128 kilobits per second	2 DS0 lines
T1	1.544 megabits per second	24 DS0 lines
T3	43.232 megabits per second	28 T1s
OC3	155 megabits per second	84 T1s
OC12	622 megabits per second	4 OC3s
OC48	2.5 gigabits per seconds	4 OC12s
OC192	9.6 gigabits per second	4 OC48s

ISDN = Integrated Services Digital Network.

The vast majority of Internet connections in developing Asia-Pacific countries provide connectivity at far less than 56 kilobits per second. Many Internet cafes in the region have 10 to 20 PCs linked to a 14.4 kilobit (or less) connection. If all 10 PCs are in use, it may take four or five minutes for a single Web page with graphics to load—thus the cynical variant name for the World Wide Web (www) as "World Wide Wait." Most connections located behind a Private Business eXchange (PBX) (an electronic switchboard) in a hotel or government building, for instance, are on analog lines, even though the PBX has unused digital capacity that local experts often do not know how to use. Thus, bandwidth is limited to 33.6 kilobits, no matter what the modem monitor reports to the user on the computer screen.

Although affordable high-capacity Internet connectivity should normally be available to citizens of all countries by 2005, the old dial-up connection is still the standard means of access for most of the globe's population. It is interesting to compare costs for access to information that should not be very different between countries, since hardware, labor, and international connectivity costs are equivalent (except for small island states and landlocked countries where relatively expensive satellite feeds are needed). Even in these latter cases, there exist solutions that allow affordable connectivity which are unfortunately not used.[72] One may conclude that the ICT policy and regulatory framework of the higher-cost countries are less than optimal, and this issue is severely constraining the economic and social development of those nations.

[72] Refer to note on cacheing.

Table 3, compiled from the ITU's *Asia Pacific Telecommunications Indicators 2002*, provides a comprehensive overview of the cost of access to the Internet for Asia-Pacific countries. It should be kept in mind, however, that these data do not account for actual performance of these Internet connections. It is well known that many Internet connections, even in popular Internet cafes, are not very useful for browsing since the time to download a single page often exceeds a minute.

The data in Figure 3, organized in order of costs, does not give us any clue or insight to explain such wide disparities in charges. Tonga shows relatively low monthly connection costs ($18.87), yet it is an isolated, small island country where the only electronic communication with the outside world is through expensive satellite links. On the other hand, Papua New Guinea ($52.51) has better international connectivity, as does Japan ($42.07)—with one of the world's best infrastructures and higher average charges than Bangladesh, Pakistan, and Indonesia.

Another indicator of access to information is the number of PCs per 100 people in each country, shown in Table 4. The information should be considered a general indicator for comparison purposes only; many PCs in government offices are underutilized and assigned to a single user for limited hours per day, while others—in Internet cafes, for instance—may have as many as 20 users a day for up to 12 hours of operation. In addition, there is no available breakdown for performance—e.g. 386 processors are still in use in many countries, and the local inventory can range from a 386 system to a modern Pentium 4. The data below also is not necessarily precise, because many owners bring PCs into their country in components for later assembly, due to high duties and taxes on finished products.

In the Information age, there is a tremendous difference in purpose and capability, if we compare PCs connected to the Internet with those that are not (i.e stand alone PCs). Connectivity implies constant access to current information, while stand-alone limits the user to static applications—such as writing, drawing, and calculating—with output that must be printed, and shared and forwarded by other means.

Table 3: Dial-Up Internet Access Prices (30 hours per month in dollars, as of October 2002)

Country	ISP Sign-Up Fee (1)	ISP Monthly Fee (2)	ISP Free Hours (3)	ISP Excess Time (4)	ISP Total Charge (5)	Telephone Call Charge (6)	Total Cost (7)
Lower-income	**10.85**	**20.72**	**18**	**14.08**	**34.79**	**8.51**	**43.31**
Bangladesh	17.92	–	–	12.90	12.90	18.28	31.18
Bhutan	–	30.73	30	–	30.73	12.71	43.44
Cambodia	30.00	30.00	13	37.40	67.40	18.00	85.40
PRC	–	–	–	9.78	9.78	4.35	14.13
Fiji Islands	14.47	27.94	25	10.81	38.75	1.58	40.33
India	–	5.02	25	0.95	5.98	10.17	16.15
Indonesia	4.39	9.75	25	1.71	11.45	11.40	22.85
Kiribati	20.73	16.58	–	124.35	140.93	2.80	143.73
Lao PDR	58.00	33.00	35	–	33.00	9.05	42.05
Malaysia	6.58	0.53	–	4.74	5.26	7.11	12.37
Maldives	–	65.36	40	–	65.36	–	65.36
Nepal	–	13.34	*	–	13.34	6.00	19.35
Pakistan	–	–	–	9.69	9.69	10.17	19.86
Papua New Guinea	7.37	11.80	–	14.16	25.96	26.55	52.51
Philippines	–	19.42	30	–	19.42	–	19.42
Samoa	8.62	29.09	40	–	29.09	20.69	49.78
Solomon Islands	21.70	43.40	10	75.94	119.34	—	119.34
Sri Lanka	11.19	5.59	30	–	5.59	14.77	20.36
Thailand	–	–	–	5.40	5.40	2.03	7.43
Tonga	14.15	18.87	*	–	18.87	–	18.87
Vanuatu	34.41	75.70	40	–	75.70	–	75.70
Viet Nam	–	–	–	15.89	15.89	7.21	23.10
Upper-income	**13.86**	**25.83**	**25**	**0.85**	**23.71**	**14.04**	**37.75**
Brunei Darussalam	–	16.76	24	5.43	22.19	–	22.19
Hong Kong, China	–	17.69	*	–	17.69	4.62	22.31
Republic of Korea	23.24	23.24	A	–	23.24	–	23.24
Singapore	–	–	–	–	–	10.56	10.56
Taipei,China	95.24	47.08	A	–	47.08	–	47.08
Developed	–	**22.94**	–	–	**22.94**	**1.14**	**24.08**
Australia	–	15.00	*	–	15.00	3.42	18.42
Japan	–	42.07	A	–	42.07	–	42.07
New Zealand	–	11.74	*	–	11.74	–	11.74
ASIA-PACIFIC	**10.40**	**22.14**	**18**	**9.44**	**30.70**	**9.07**	**39.78**

(1) Registration / connection charge for signing up with ISP.
(2) Monthly fee payable to ISP. If free monthly hours are included, they are shown to the right.
(4) Extra charges once free hours have been used up. Peak and off-peak rates have been averaged.
(5) The total amount payable to the ISP per month based on 30 hours usage.
(6) Amount payable to telephone company for local telephone charges while logged on. Peak and off-peak rates have been averaged. Flat rates are converted to 30 one-hour calls.
(7) ISP charges + Local telephone charges

ISP = internet service provider, PDR = People's Democratic Republic, PRC = People' Republic of China, — = zero or datra not available.

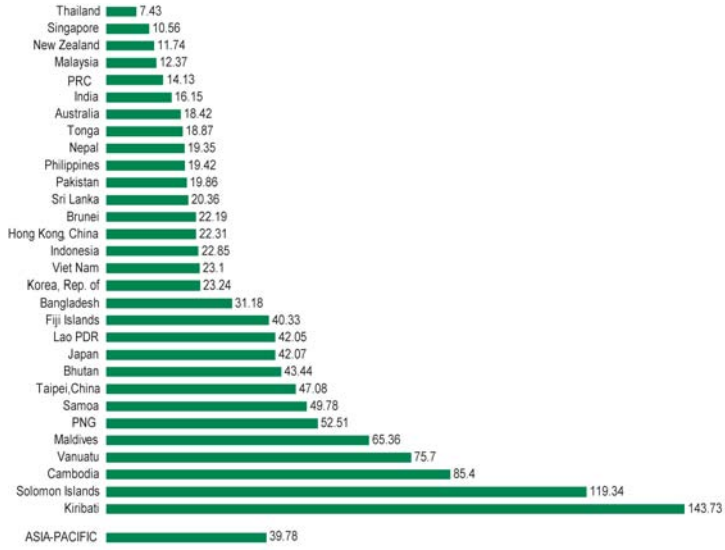
Source: Adapted from ITU analysis of ISP and telephone operator data.

Table 4: Number of Personal Computers per 100 of Population in Asia-Pacific Countries

Country	1999	2000	2001	2002
Region - Eastern Asia				
People's Republic of China	1.22	1.59	1.90	–
Macao, China	13.72	15.91	17.86	21.02
Mongolia	1.02	1.26	1.46	–
Region - South-central Asia				
Bangladesh	0.10	0.15	0.19	0.34
Bhutan	0.46	0.76	1.04	1.45
India	0.33	0.45	0.58	–
Iran	5.58	6.28	6.97	–
Kyrgyz Republic	–	–	1.28	1.27
Maldives	1.89	2.04	2.19	3.58
Nepal	0.27	0.31	0.35	–
Pakistan	0.43	0.42	0.41	–
Sri Lanka	0.57	0.73	0.93	1.32
Region - Southeast Asia				
Brunei Darussalam	6.22	6.93	7.31	–
Cambodia	0.11	0.11	0.15	–
Indonesia	0.92	1.02	1.10	–
Lao People's Democratic Republic	0.23	0.27	0.30	0.33
Malaysia	8.25	9.45	12.61	–
Myanmar	0.11	0.11	0.11	–
Philippines	1.69	1.93	2.17	–
Thailand	2.30	2.43	2.78	–
Viet Nam	0.64	0.75	0.86	0.98
Region – Oceania				
Fiji Islands	4.24	4.46	4.63	4.80
French Polynesia	22.4	32.19	28.00	–
Kiribati	0.84	0.94	1.05	–
Marshall Islands	2.95	3.80	4.58	5.30
Papua New Guinea	4.83	5.46	5.67	–
Samoa	0.51	0.57	0.62	–
Solomon Islands	3.42	3.81	3.93	4.05
Tonga	1.12	1.32	1.42	–
Vanuatu	0.06	0.08	0.08	0.09
Asia - Developed				
Australia	42.25	46.98	51.58	–
New Zealand	33.31	36.55	39.26	–
Hong Kong, China	30.28	35.41	38.66	–
Korea, Republic of	25.23	40.48	48.08	55.58
Singapore	43.03	48.31	50.83	–
Japan	28.66	31.52	35.82	38.25

– = data not available.
Source: Adapted from United Nations Millennium Indicators

Figure 3
Monthly Dial-Up Internet Costs in Asia–Pacific Countries in October 2002
($)



PDR = People's Democratic Republic, PNG = Papua New Guinea, PRC = People's Republic of China.

Source: Table 4.

Table 5: Number of Internet Users, Asia-Pacific Countries

Country	Population	Internet Users	Users as a Percentage of Population	Rank
Australia	19,500,000	12,820,000	65.74	1
Hong Kong, China	7,300,000	4,570,000	62.60	2
Republic of Korea	48,300,000	25,600,000	53.00	3
New Zealand	3,900,000	2,060,000	52.82	4
Singapore	4,452,000	2,310,000	51.89	5
Taipei,China	22,500,000	11,600,000	51.56	6
Japan	127,000,000	56,000,000	44.09	7
Malaysia	22,600,000	5,700,000	25.22	8
Macau, China	461,900	101,000	21.87	9
Thailand	67,000,000	12,000,000	17.91	10
New Caledonia	207,800	24,000	11.55	11
Philippines	84,500,000	4,500,000	5.33	12
Papua New Guinea	5,170,000	135,000	2.61	13
Indonesia	231,000,000	4,400,000	1.90	14
Maldives	320,165	6,000	1.87	15
Fiji Islands	856,300	15,000	1.75	16
Solomon Islands	494,786	8,400	1.70	17
Samoa	178,631	3,000	1.68	18
Brunei	2,100,000	35,000	1.67	19
Vanuatu	196,100	3,000	1.53	20
Federated States of Micronesia	135,800	2,000	1.47	21
Marshall Islands	73,630	900	1.22	22
Kyrgyz Republic	4,800,000	51,600	1.08	23
Kiribati	96,300	1,000	1.04	24
Tonga	106,100	1,000	0.94	25
Pakistan	147,600,000	1,200,000	0.81	26
India	1,000,000,000	7,000,000	0.70	27
Sri Lanka	19,570,000	121,500	0.62	28
Kazakhstan	16,700,000	100,000	0.60	29
Viet Nam	81,098,000	400,000	0.49	30
Uzbekistan	25,560,000	100,000	0.39	31
People's Republic of China	1,300,000,000	4,570,000	0.35	32
Azerbaijan	7,800,000	25,000	0.32	33
Nepal	25,870,000	60,000	0.23	34
Lao People's Democratic Republic	5,770,000	10,000	0.17	35
Bhutan	2,100,000	2,500	0.12	36
Bangladesh	133,300,000	150,000	0.11	37
Tajikistan	6,700,000	5,000	0.07	38
Turkmenistan	4,600,000	2,000	0.04	39
Afghanistan	27,800,000	–	–	–
Cook Islands	1,300,000	–	–	–
East Timor	952,618	–	–	–
Nauru	12,300	–	–	–
North Korea	22,200,000	–	–	–
Tokelau	1,400	–	–	–
Tuvalu	11,100	–	–	–
Total	3,421,894,930	144,892,900	–	–

– = data not available.

B. The Current Status of ICT in Asia-Pacific Countries

ICT development varies tremendously among countries, and among regions in the same country. In some countries, it is a struggle simply to achieve basic affordable and reliable connectivity in urban areas (Kiribati, Pakistan, Nepal, Philippines). Others have a sound of initiatives in specific cities or towns (Malaysia, Sri Lanka, Indonesia), and practically no ICT facilities elsewhere. Yet other countries have achieved a degree of maturity in advanced applications in a special region (Bangalore, India), while most of the rest of the country can't connect reliably to the Internet, and the national backbone pipelines that should carry data between cities are still clogged. Elsewhere, specific technologies are well-mastered and spreading—e.g. financial management in Samoa and the Federated States of Micronesia—while little progress is seen elsewhere, such as in health and education sectors.

In sum, there is no easy way to classify countries into clearly defined groups, since there are so many exceptions, and extreme variations within a single country. We will attempt, however, to gather Asia-Pacific countries into three broad categories. The first category covered comprises the fully developed nations, where ICTs are mature and there is good local capacity to build and expand. We will include in this group a few countries where the policies and plans may not be as well-defined and implemented as in others in this group. In these few countries, however, there is a substantial track record of ICTs in core sectors such as business, administration, and education, such that—*caeteris paribus*—there is enough momentum and capability to push knowledge-based applications into other fields and further into rural and remote areas. There may in some cases be hindering issues, such as bandwidth and affordability, but they are not seen as long-term obstacles to equitable national deployment of ICTs in education.

Advanced Nations

In the first group is Australia, the Republic of Korea, Japan, New Zealand, Singapore, Taipei,China, and Hong Kong, China. The latter two will be discussed in greater detail in the section on PRC. We present basic data, policies, and strategies as they influence ICT and education for those countries where the relevant information is current and available.

Countries in this group will usually have a national ICT master plan, and within this, national ICT policies and strategies in education with corresponding implementation plans and budgets. They will have implemented ICT in several sectors, and they are far enough on the learning curve to become autonomous in advancing their own national ICT agenda. As a result, most learners in these countries have access to computers and complementary equipment and software in their classrooms, as well as reliable Internet access at better than dial-up capacity in many instances. These countries have also revised their curriculum to integrate ICT into the quotidian of learning. In addition, learning at all levels is moving more and more online, with e-learning facilitated by wide access to the Internet and connectivity from the home or the office.

Human resource development is a key component of ICT strategy, and performance incentives may come into play for administrators, teachers, support specialists, tutors, and content developers. Teacher, administrative, and specialist training are increasingly available online and with a high degree of quality that goes far beyond simple training in computer literacy. The aim is to stimulate full integration of ICTs in the curriculum, in administration, and in teaching various subjects. Teachers' presentational skills are honed, and they are often able to plan and share their courses, professional interests, and help notes online through school Web sites or on a national Schoolnet. They are becoming guides and motivators, rather than lecturers and disciplinarians. The traditional isolation of educators in more rural areas is no longer a major problem, thanks to e-mail and chat rooms that connect them with their peers, their administration, and their community.

a. Australia

Population	19,731,984	(2003 estimate)
GDP per capita ($)	19,020	(2001)
Number of mobile phones per 1000 people	519	(2001)
Number of Internet hosts per 10,000 people	1,180	(2001)
Literacy rate, Total (%)	100	
Literacy rate, Female (%)	100	
Literacy rate, Male (%)	100	
Education expenditure as a percent of GNP	4.6	(1999–2000)
Number of years of compulsory schooling	11	(2000)
Number of students per teacher, primary school	17	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database, Encarta 2003, and CIA Fact Book.

Integrated Policy. In 2000, Australia adopted its imaginative and forward-looking policy entitled "Learning for the Knowledge Society—an Education and Training Action Plan for the Information Economy," developed by the Australian National Training Authority. Australia offers a good model where most constraints and the interdependencies of communications and intellectual property policies, infrastructure development, competitiveness, regulatory influences, and the business and economic environment, are all taken into account in crafting the education policy.

The Australian policy recognizes at the outset that "The education and training industry produces skilled people, creates knowledge, provides access for the community to the lifelong benefits of online learning and is an enabling force for all other industries."

This Action Plan is a focus for change in the education and training sector. It establishes a framework under which all stakeholders can:

- Develop strategies and implement key initiatives to ensure that all citizens possess broad literacy, numeracy, and

technological literacy skills for life, work, and lifelong learning, and that there are adequate numbers of people with the specialist skills needed by the ICT industries and other Australian industries to service the needs of the economy;

- Improve their understanding of the social, cultural, and economic impact of the information economy on education, training, research, and development; and
- Reconsider the ways they do business to achieve and maintain their national and international competitiveness.

The Plan identifies outcomes that the education and training industry must achieve if it is to play its enabling role in supporting Australia's transition to the information economy and maintain its place as one of Australia's major export earning industries.

The Plan sets out five interrelated Action Areas under which strategies must be implemented. Each Action Area is equally important and needs to be addressed in an integrated way to achieve the purpose of the Plan. The Action Areas are:

- **People.** Supplying the skills to drive the information economy. This includes the leaders and workers with the vision and skills to develop and manage new approaches to learning and to implement coordinated and timely change. Professional development for teachers, trainers, content developers, researchers, and all other workers in education and training is essential to allow them to be change agents to achieve the goals of the information economy. Working with other industries to develop the specialist skills needed to ensure that Australia is able to take its place in the global information economy.
- **Infrastructure.** Ensuring access at an affordable price to advanced telecommunications and information technology infrastructure, including high bandwidth. This includes reliable and sustainable infrastructure support systems within and between education, training, and research providers to ensure interoperability. Infrastructure provision and the conditions to allow research and development links between education and training providers and industry are also important to enable the education and training industry to conduct its business efficiently and effectively.

- **Online Content, Applications, and Services.** The sector needs to invest in new approaches to education and training content, applications, and services that enhance the learning experience in Australia and develop leadership internationally. How content, applications, and services are delivered is a key element in the value chain for Australia's education, training, and research industries. Australia is a small market and development costs are high. Education and training must cooperate with the private sector to promote an active and productive content and services delivery market.
- **Policy and Organizational Framework.** Governments need to develop a comprehensive policy framework for education and training, including research and development, that supports the information economy and a knowledge society. Policies at all levels (national, system, and organizational levels) must articulate a vision for the future, provide for a level of investment to effect change and promote equity and access, and enable Australia's education and training industry to become nationally effective and internationally competitive. Education and training organizations must improve their planning and change management strategies to ensure the agreed outcomes are achieved.
- **Regulatory Framework.** Telecommunications, intellectual property management models, online content, e-commerce, and a range of other regulatory frameworks need to be in place so that the education and training industry can operate efficiently and effectively and become internationally competitive. Effective copyright legislation is especially important, because in a knowledge-based society intellectual property is currency. Regulatory and technical frameworks will need to reflect international developments and should support and not impede the needs of Australia's education and training industry.

Current Situation. From a consumer's perspective, there are still a number of frustrations, since even dial-up connections are relatively expensive. Limited throughput ISDN is still used as the broadband connection; it is expensive, and not available everywhere. ADSL, as used in North America at 1.3 megabits or better, has not yet been introduced in the marketplace.

b. Japan

Population	127,334,000	(2001)
GDP per capita ($)	32,600	(2001)
Main lines per 100 inhabitants	60	(2001)
Main lines per 100 households	158	(2000)
Number of mobile phones per 100 inhabitants	59	(2001)
Number of Internet hosts per 10,000 people	559	(2001)
Literacy rate, Total (%)	99	(1995)
Literacy rate, Female (%)	99	(1993 estimate)
Literacy rate, Male (%)	99	(1993 estimate)
Education expenditure as a percent of GNP	3.5	(1999–2000)
Number of years of compulsory schooling	10	(2000)
Number of students per teacher, primary school	21	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Japan has adopted a Basic Policy where the private sector plays a lead role. Under the Basic Policy, the e-Japan Priority Policy Program of 29 March 2001 focuses on five key result areas:

- Formation of the world's most advanced information and telecommunications networks.
- Promotion of education and development of human resources.
- Facilitation of e-commerce.
- Digitization of administration and application of IT in other public areas.

[73] See http://www.mext.go.jp/english/index.htm.

- Ensuring security and reliability of advanced information and telecom networks.

ICT in Education. The Ministry of Education, Culture, Sports, Science and Technology's Education Reform Plan for the 21st Century,[73] "The Rainbow Plan—The Seven Strategies," briefly mentions ICTs in the First Strategy: to Improve students' basic scholastic proficiency "in easy to understand classes" with the objective of improving classrooms in order to be able to conduct IT classes and (achieve) the 20 students per class system (establish "A Learning Environment for the New Generation").

c. Republic of Korea

Population	47,740,000	(2001)
GDP per capita ($)	8,920	(2001)
Main lines per 100 inhabitants	48	(2001)
Main lines per 100 households	141	(2000)
Number of mobile phones per 100 inhabitants	61	(2001)
Number of Internet hosts per 10,000 people	94	(2001)
Literacy rate, Total (%)	98	(2003 estimate)
Literacy rate, Female (%)	97	(2003 estimate)
Literacy rate, Male (%)	99	(2003 estimate)
Education expenditure as a percent of GNP	3.8	(1999–2000)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	32	(1999–2000)

GDP= gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The Republic of Korea's National Basic Information System is composed of five elements: administration, finance, education and research, defense, and national security. Within the "Bridging the digital divide" component, the Korea Agency for Digital Opportunity and Promotion develops and runs programs for awareness, regional information, and computer education. It has developed a *Comprehensive Plan for resolving Digital Divide* (2001) and completed ICT education for 10 million people (21% of the population) in 4,397 free-of-charge information facilities set up in remote and rural areas. In addition, to provide universal access, Korea Telecom must provide broadband Internet service (1 Mbps) to all farming and fishing villages by 2005.

ICT in Education. According to UNESCO, as of April 2001, all schools had free access to the Internet until 2005. Furthermore, the computer/student ratio is high, with an average of 10 students per PC at primary schools; 7 students per computer in middle schools and 5 students per computer in high schools. All classrooms are fully equipped, most with multimedia. ICT is integrated into the curriculum, with 10—20% usage of ICT in every subject aimed at enhancing higher-order thinking skills. Training of educators is an ongoing and regular activity where 33% of teachers are trained annually with teacher ICT literacy certification.

d. Singapore

Population	4,131,200	(2001)
GDP per capita ($)	20,730	(2001)
Main lines per 100 inhabitants	47	(2001)
Main lines per 100 households	202	(2000)
Number of mobile phones per 100 inhabitants	72	(2001)
Number of Internet hosts per 10,000 people	479	(2001
Literacy rate, Total (%)	93	(2003 estimate)
Literacy rate, Female (%)	90	(2003 estimate)
Literacy rate, Male (%)	97	(2003 estimate)
Education expenditure as a percent of GNP	3	(1995)
Number of years of compulsory schooling	Not available	
Number of students per teacher, primary school		25 (1999–2000)

GDP= gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The Infocomm Development Authority of Singapore (IDA) is a statutory board of the Singapore Government that operates under the Ministry of Information, Communications, and the Arts. Among IDA's main responsibilities are: fostering a competitive, world-class infocomm industry in Singapore, preparing residents for living and working in the "New Economy," spearheading the delivery of citizen-centered e-government services, and building and operating the government's IT infrastructure.

IDA is guided by Connected Singapore, a master plan that maps out the vision, strategies, and goals to entrench Singapore as one of the world's premier infocomm capitals. One of the main themes of Connected Singapore is the creation of partnerships, not only between industry and government, but within industry, and between Singapore and other markets in Asia, North America, and Europe.

IDA will implement programs under four key strategies to bring about the realization of the Connected Singapore vision.[74] The IDA is responsible for the development, promotion, and regulation of Singapore's infocomm industry. As a regulator, IDA formulates clear and transparent policies to ensure a fair and balanced competitive environment. As a "catalyst" for the New Economy, IDA offers IT training programs that encourage adoption of an e-lifestyle among Singapore residents, as well as infocomm skill development. Singapore is aggressively recruiting international infocomm talent from abroad, and IDA is building ties with overseas infocomm training centers.[75]

ICT in Education. Singapore's key policy is contained in Master Plan II for IT in Education (abbreviated as mp2).[76] In the first Master Plan (1997), the underlying rationale was that students needed to acquire skills, such as the ability to think independently and creatively, to be competent and confident problem-solvers, and to be lifelong learners. The use of IT was seen as a means of preparing students with such skills, and it was thus be important to equip schools and teachers with the necessary infrastructure.

This rationale is still applicable today. The government sees technology as a key enabler in making student-centered learning and assessment a reality, and in helping to reach the goal of ability-driven education and the vision of "Thinking Schools, Learning Nation." The Second Master Plan aims to build on what has been achieved in the first, and bring the use of IT in education to greater heights.

The Second Master Plan adopts a systemic and holistic approach. All the key pieces—curriculum, assessment, instruction, professional development, and culture—of the school are integrated and addressed. The approach calls for the involvement of the major stakeholders in education and emphasizes that they work together to tap the potential of IT.

[74] See:http://www.ida.gov.sg/idaweb/aboutida/infopage.jsp?infopagecategory=&infopageid=I2227&versionid=10.

[75] Adapted from IDA's mandate and functions at http://www.ida.gov.sg.

[76] See http://www.moe.gov.sg/edumall/mp2/mp2_home.htm.

The outcomes include:

- Pupils use IT effectively for active learning.
- Connections between curriculum, instruction, and assessment are enhanced using IT.
- Teachers use IT effectively for professional and personal growth.
- Schools have the capacity and capability in using IT for school improvement.
- There is active research in IT in education.
- There is an infrastructure that supports widespread and effective use of IT.

The goals and strategies include:

- **IT in curriculum and assessment**. This includes (i) integrating IT into content to create a dynamic and flexible curriculum, and (ii) leverage on IT to expand the scope and nature of assessment.
- **Professional development**. Teachers are the key to the effective use of IT to enhance teaching and learning. The focus of professional development is to create sustainable proficiency and to meet the varied needs of teachers, who are at different stages of IT use in their curriculum by (i) developing an integrated and sustained model of professional development for IT in education, (ii) promoting an e-learning culture, and (iii) creating enabling structures to recognize and sustain teachers.
- **Capacity and capability building**. A strong IT culture in schools will depend greatly on building the capacity and capability of schools to use IT effectively to enhance teaching and learning processes. To do this, mutually-supportive strategies are needed, such as, (i) active promotion of IT in education, (ii) sustained support and enabling structures for schools, and (iii) empowerment of schools with more autonomy through leadership capacity building.

- **Research and development**. There is a need to initiate an R&D program for IT in education to research how pupils learn and how IT can best be deployed to support learning and achievement, so that educators and policy makers can be better informed about the most effective uses and impact of technology and telecommunications in education.
- **Infrastructure and support** by (i) providing dependable, flexible, and safe network access; (ii) providing a multi-purpose, multi-functional, pervasive, and ubiquitous IT-enriched environment; and (iii) providing IT support services.

As teachers and pupils will increasingly be accessing rich online resources, access should be readily available as and when needed. The infrastructure should be able to support the delivery of rich multimedia instructional content.

Increasingly, schools are also making requests for an IT-enriched learning environment with full capabilities and easy access to computing devices and power to support a range of teaching and learning needs. When schools are provided with more and varied IT equipment, there will also be the need for more and relevant technical support to maintain the system.

The first Master Plan was about equipping schools with basic provisions and teachers with basic skills and knowledge to integrate IT into the curriculum. With the strategies and projects proposed in mp2, the focus is to sustain the momentum gathered today and to bring the use of technology in education to greater heights tomorrow, as illustrated in the table below:

Table 6: Today and Tomorrow

TODAY	TOMORROW
Use of IT to support existing curriculum	Seamless integration of technology at the planning stage of curriculum design
Largely static content in print form	A repository of dynamic digital content
One size fits all approach	Mass customization and ability-driven approach
Teacher demonstrate basic skills and competencies in the use of IT for teaching	Teachers demonstrate a range of competencies in the use of IT for teaching
Phased approach in the implementation of technology in schools	Schools have greater ownership and accountability in technology implementation
Standard technology provisions for all	Flexible technology provisions for all
Predominantly teacher-centered pedagogies	Predominantly pupil-centered pedagogies

e. New Zealand

Population	3,890,000	(2001)
GDP per capita ($)	13,100	(2001)
Main lines per 100 inhabitants	47	(2001)
Main lines per 100 households	146	(2000)
Number of mobile phones per 100 inhabitants	62	(2001)
Number of Internet hosts per 10,000 people	1,069	(2001)
Literacy rate, Total (%)	99	(1995)
Literacy rate, Female (%)		Not available
Literacy rate, Male (%)		Not available
Education expenditure as a percent of GNP	7.4	(1999–2000)
Number of years of compulsory schooling	12	(2000)
Number of students per teacher, primary school	15	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The government was updating its core ICT strategy, to be completed by the first-half of 2004. The previous strategy was formulated in 1999, and its objectives have either been achieved or are well under way. The new strategy formulation follows the identification of ICT as one of the three core areas for New Zealand innovation. Hence it is likely to concentrate on ways of encouraging the growth of the ICT industry itself, as well as on the role of ICT as a facilitator of industry in general and a factor in the evolution of society.[77]

[77] Computerworld New Zealand, Wednesday, 1 October, 2003.

ICT in Education. New Zealand's ICT strategy has been developed to support the use of information and communication technologies and aims to:

- Improve student learning outcomes;
- Improve the teaching of ICT through the curriculum and to reduce time spent on administration tasks;
- Support principals to manage their ICT professional development needs; and
- Increase opportunities for schools, business, and government to work together to improve educational opportunities.

This strategy builds on the work of schools that are doing exciting things with ICT in teaching and learning, and provides a basis for considering the following:

- ICT can be used to support quality Maori-medium education in primary and secondary schools. Through interactive applications, ICT can facilitate oral and visual communication, along with the traditional teaching focus on written communication. This can help provide a more holistic approach to learning styles, better integrating cultural and social needs.
- For rural schools, the Internet can provide a window to the world by allowing users to interact socially with students from other schools, both nationally and internationally, and to obtain information not otherwise readily accessible to them.
- ICT has the potential to break down barriers created by distance, enabling teachers and students in urban and rural areas to access a range of learning opportunities from around the world. A number of schools with students at risk of underachievement have experimented with using a technology-rich environment to enhance their teaching and learning. Growing evidence supports the view that ICT can facilitate learning, particularly for those students at risk of failure within the current school system.
- Schools, businesses, and government all have a critical role to play in realizing the potential of ICTs to enhance teaching

and learning, to enhance student achievement, and to make school administration more effective.

The strategy consists of four new initiatives:

- **Online Resource Centre.** A centrally managed Web site that will provide all schools with a mechanism for the delivery of multimedia resources.
- **Promotion of a computer-recycling scheme.** To promote the donation of computers by industry to existing businesses for recycling and upgrading for schools. To inform schools about the availability of recycled computers.
- **Production of a planning and implementation guide for** schools and provision of professional development for principals. A one-day course for principals to enable them to better plan for the integration of ICTs into their schools, and a support guide.
- **Introduction of ICT professional development schools and clusters.** A number of schools throughout New Zealand that are successfully using ICT to enhance teaching and learning will be contracted to provide professional development to other schools directly, and indirectly, on the Online Resource Centre

All of the new initiatives build on and support the following existing initiatives:

- **Financial assistance scheme.** Government provides at least 50% of the costs of approved capital projects, including cabling for local area networking.
- **Netday**, is a national voluntary project that combines local, regional, and national resources to help schools wanting to create local area networks.
- **IT Professional Development.** The current ITPD program, which funds schools, or clusters of schools, to organize and manage their own training and development, will continue.

Evolving Countries

The evolving countries include PRC, India, Malaysia, Philippines, Sri Lanka, and Thailand. In these countries, fairly comprehensive national policies and supporting strategies for ICT have been adopted. They host credible pilot projects that are usually carefully monitored, and the lessons being learned are contributing to the mapping of future developments. In some of these countries there is strong political will that contributes to the implementation of appropriate strategies, often supported by strong budgetary commitments. In some cases there is also a combination of sector policy initiatives and pilot projects or major projects that can be expanded to offer equitable and affordable access to education and knowledge to all levels of society, including in rural and remote regions.

In other instances, the desire to adopt and utilize ICTs is constrained by modest human or financial capacity. In many cases, people in the education system recognize the needs and the potential and are strongly promoting implementation of ICTs in their sector. They even may have seen government agreement to and promotion of these plans, but have found that government usually has other priorities.

Connectivity and ICT penetration are growing, but slowly. There are scattered pockets of good connectivity and advanced ICT use in business, government, and schools, but these are usually only in prosperous urban centers. The uses of ICTs in curriculums, in teaching and learning, in materials development, and in administration, vary tremendously, not only between countries, but between cities, provinces, and regions of the same nation.

The focus of teacher training is often on basic computer literacy and standard applications, such as word processing, spreadsheets, and presentations. There is too often little interesting and worthwhile content of quality to utilize as educational material. Even if there is such content, teachers have not been trained or motivated to move away from the blackboard, the desk, and the book. Quite often, computers have been supplied in impressive numbers to schools and throughout the education system, but teachers and educators have little practical knowledge of what to do with them. In some instances, the responsibility for spreading the good word is delegated "computer clubs," suppliers, or ICT interest groups within the system.

On the other hand, there are some brilliant exceptions, especially where the private sector has developed partnerships in a socially responsible fashion, such as Schoolnet India, or the new Distance Education Partnership Programme (DEPP) in Sri Lanka. If these initiatives are carefully nurtured, stimulated, and expanded, they can provide powerful national best practice models to guide national decision makers across the digital divide, while relieving pressure on the public purse. Public-private ventures often yield better results than can be expected from government acting alone.

DE in these countries is usually available at the tertiary level, mostly through correspondence and radio or television. There are enlightened decision makers, however, who are planning moves to multimedia and interactivity bolstered by remote support and mentoring. Currently, DE institutions are frequently seen as the "University of Last Resort," and their graduates, by extension, lack credibility. Public distance education institutions—perhaps no more than the neighboring traditional institutions—often provide ICT training that is not current and does not relate to the needs of the marketplace.

Some of the barriers faced by these countries are:[78]

- Financial constraints, with secure budgets being prioritized in other sectors;
- Hardware is the target of investment, rather than creating and developing local champions and a competent absorptive environment;
- Insufficient attention is given to, first and foremost, improving the skills of teachers and administrators as facilitators and prime movers, and to enhancing their role as mentors and guides;
- Internet access may be spotty, unreliable, and very expensive; schools are not interconnected;
- There is little integration of ICTs into the curriculum or in day-to-day activities of schools;

[78] Adapted from UNESCO. 2001. *Stages of Development in ICT*. Bangkok: UNESCO.

- There are few experienced technical specialists with up-to-date knowledge;
- There is a narrow and conservative focus on traditional technology in the selection of ICTs, software, and networking;
- Local firms participating in the supply process may not have knowledge of, or access to, the most effective technologies;
- High software costs, exacerbated by a lack of national educational software licensing policies;
- Teacher trepidation in the face of ICT technology, and lack of motivation to change and improve;
- Administrators' limited vision, closed mindset, and lack of appreciation of the potential of ICT in education;
- Costs and time for maintaining and upgrading of ICT resources, and a lack of technical staff outside of major urban areas;
- Reluctance or lack of expertise to open up the assets for broader community use; and
- Limited availability of educational software and courseware in local languages, or that is adapted to local cultures or practices.

a. People's Republic of China

Population	1,296,140,000	(2001)
GDP per capita ($)	910	(2001)
Main lines per 100 inhabitants	14	(2001)
Main lines per 100 households	42	(2000)
Number of mobile phones per 100 inhabitants	11	(2001)
Number of Internet hosts per 10,000 people	0.68	(2001)
Literacy rate, Total (%)	86	(2003 estimate)
Literacy rate, Female (%)	79	(2003 estimate)
Literacy rate, Male (%)	93	(2003 estimate)
Education expenditure as a percent of GNP	2.1	(1999–2000)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	20	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT in Education. No single cohesive policy on ICT has been published. ICTs are used in education, especially at the tertiary level, i.e. for open and distance education. PRC strategy, as enunciated in speeches by senior officials,[79] is to transform its huge population into valuable human resources through innovation and "big-stride" development, with education as a major priority. Goals include the implementation of quality-oriented education innovation, making optimal use of ICT in education, restructuring the educational system, and strengthening the links between education, the economy, and society. Strategies to achieve these goals focus on:

[79] PRC presentation at 2nd APEC Education Ministerial Meeting, Sub-theme (b) Improving Teaching System Discussion Paper Innovation of Education for the 21st Century.

- Increasing educational spending;
- Redefining the role of students toward encouragement of independent; innovative, and creative thinking;
- Reducing the workload of students;
- Reforming teaching content and teaching methods; and
- A renewal of the examination and assessment system.

By the end of 2003, it was expected that over 10 million schoolteachers and several hundred thousand headmasters will have taken specialized training through continuing education, especially in computer applications and information technology.

The PRC goal was to establish 6000 distance education centers in the Western Provinces by the end of 2003, and to connect 90% of primary and secondary schools to the Internet by 2010. The application of information technology in education will be pushed forward on three levels:

- Spread and use educational technology in schools with multimedia computer technology as the core.
- Promote the popularization and application of networks.
- Develop modern distance education, build up and provide extensive network resources, and establish a lifelong learning system with this as the platform.

Government implementation of technology extends to the establishment of China Education and Research Network (CERNET), which is to link over 70 cities and 400 institutions of higher learning, with more than 2.5 million users—25% of all network users in PRC.[80] In mid-October 2003, the Ministry of Education, in conjunction with a dozen universities and IBM, was to launch CERNET, a project that could eventually connect as many as 200,000 students in 100 universities across the country.[81]

[80] Adapted from UNESCO Bangkok, draft report "ICT policies of selected countries in Asia-Pacific."
[81] InfoWorld, October 13, 2003.

Current Situation. The PRC is without a doubt the world's largest mobile phone market, with an awe-inspiring 221.5 million mobile subscribers by March 2003. Despite this country being fertile ground for mobile services, operators are experiencing serious difficulties. China Mobile and China Unicom, the two main mobile operators, are not only engaged in fierce competition, but they also have to contend with the spread of the "Little Smart" Personal Access System handy phones offered by China Telecom and China Netcom. Though the Little Smart system is only approved for rural areas, the government seems to be turning a blind eye to its encroachment into the major cities.

The PRC Internet market is the fastest growing in Asia. With an estimated 60 million Internet users by early 2003, PRC overtook Japan as the world's second largest Web population after the US. By end 2003, this figure is expected to increase to 80 million.[82]

b. Hong Kong, China

Hong Kong deserves special mention because of its unique status as an advanced user of ICTs in all segments of the economy, and its intense focus on the most appropriate applications of ICTs in education.

In 1998, *The Information Technology for Learning in a New Era—Five-year Strategy 1998/99 to 2002/03* document was released by the Education and Manpower Bureau (EMB). The document promoted the adoption of innovative pedagogical practices by facilitating the implementation of IT education so as to achieve a paradigm shift. To accelerate the introduction of IT in learning and teaching, EMB provided generous resources and support in terms of IT facilities in schools, curriculum, and teaching resources, including teacher training.

IT Infrastructure, Access, and Connectivity. To ensure that students have adequate opportunities with computers and increased access to the Internet, 40 computers have been provided for each primary school and 82 computers for each secondary school. At present, there is an average of 78 computers in each primary school

[82] 2003 Telecommunications and Information Highways in Asia: Volume 3 China, 9th Edition, Global Information Inc.

(the student to computer ratio is 7.68:1), whereas in secondary schools, the average number is 225 PCs per school (the student to computer ratio is 4.42:1). In addition, 103 Multimedia Learning Centres are coming into operation, and the Quality Education Fund has approved 163 more such centers to enhance opportunities for students to learn in a technology-rich environment.

All schools are connected to the Internet, with over 90% using broadband connections. Most secondary schools and over 75% of primary schools have set up their own homepages on the Internet to communicate with the outside world.

Teacher Enablement. All 46,000 teachers and 4,600 teaching assistants in Hong Kong have completed IT competency training at the Basic Level. At this level, a teacher is able to master general computer operations and skills such as word-processing, surfing the Internet, and using readily available educational software. In addition, 35,600 teachers have achieved the Intermediate Level (IIT), where they are able to use IT tools and make use of teaching resources available on the Internet and the Intranet in classroom teaching and lesson preparation. 12,500 teachers have attained the Upper Intermediate Level and 2,600 teachers the Advanced Level. At the Upper Intermediate level, a teacher is able to handle computer networking, resolve simple hardware and software problems, make more advanced use of author ware for lesson preparation etc., and understand the characteristics and uses of different IT tools and resources. At the Advanced Level, a teacher is able to understand the functions of computer managed instruction systems, evaluate the effectiveness of instructional computer programs, design instructional materials using specialized applications, and select appropriate IT equipment to meet a school's needs.

Besides the four levels of IT training, EMB will continue to identify the training needs of school teachers and school heads for organizing subject-based and skill-based IT in education refresher training courses. The aim is to further promote the use of IT in learning and teaching, with a view especially to facilitating the implementation of curriculum reform.

Curriculum and Resource Support. Nearly 3,200 software packages suitable for the teaching of various subjects in primary and secondary schools are available for teachers' reference in the software

preview library. Depending on the needs of individual schools, teachers decide whether to procure software after previewing it.

Current Situation. The Hong Kong Academic and Research Network has been connected to the high performance Internet2 network in the United States (same as CA*net 4 in Canada) for local universities to carry out collaborative research on the next generation of Internet technologies with their North American counterparts. The aim is to develop advanced Internet technologies to significantly improve the performance of the Internet so as to enable the operation of advanced Internet applications, such as video broadcasting and conferencing, DL, tele-medicine, and a digital library of innovative contents.

The network was first used to demonstrate a series of real time, interactive virtual classroom sessions between Hong Kong and Canadian students during ITU TELECOM Asia 2002 in December. It was then used between local and overseas universities to support research projects that involved real-time transmission of large volumes of data, e.g. weather information and DNA data, videoconferencing, and multicast programs.[83]

It is also worthwhile to mention the Open University of Hong Kong, which has achieved an excellent reputation internationally for the quality of its education and of its administration.[84]

c. Taipei,China

ICT Policy. The mandate of the National Information and Communications Initiative Committee (NICI) is to accomplish the following missions: (i) accelerate the development of the IT industry, e-commerce, and related business, (ii) improve the efficiency of government services, (iii) promote Internet use and related applications, and (iv) uplift the competitiveness of the IT industry. NICI has launched an ICT project which was formally approved by the Executive Yuan in June of 2002. Some of the primary objectives of this project are to:

[83] Source: Canadian Consulate General in Hong Kong.
[84] See: http://www.ouhk.edu.hk/.

- Innovate information and communication technology on the solid foundation built over past years;
- Establish a highly efficient government that will provide friendly and timely services to all its citizens;
- Uplift the competitiveness of the IT industry to gain leading advantages in the global market;
- Realize an elegant society that is rich in knowledge, culture, entertainment, and learning opportunities for ALL, and commits to eliminate the digital divide;
- Accelerate the transition into the knowledge-based economy for business to thrive for many years to come. In the end, this will transform Tapei,China into an optimal, high-tech, green silicon island, and the ***e***-Leader in Asia.

There are five integral parts within this plan: "6 million broadband users," "***e***z Life," "***e***-Industry," "***e***-Government," and "***e***-Transportation."[85]

ICT in Education. This sector is included in the ICT project under the component "***e***z Life," which will implement the following tasks in order to realize an elegant society that is full of opportunities for all its citizens: (i) create advanced ***e***-learning environments, (ii) install the national archive system and digital content online services, (iii) create digital entertainment facilities, (iv) install national cultural information data bases and digital libraries to provide instant information retrieval services, (v) install public information stations, such as Kiosks in remote areas to minimize the digital divide if it cannot be eliminated totally, and (vi) equip small and medium-size businesses and farming communities with the appropriate digital facilities and services.

Current Situation. Although the growth rate of Taipei,China's online population has slowed, the composition of the Internet subscriber base has undergone tremendous changes. The broadband market has grown very quickly and the penetration rate ranks with that of the world leaders. According to a survey released by eMarketer in June 2002, the broadband penetration rate in Taipei,China households had reached 18.2%, ranking the fourth worldwide, after the Replublic of Korea, Hong Kong, China, and Canada. The research

[85] Adapted from: http://www.nici.nat.gov.tw/doctemp/English%20Version%209112_FIND.pdf.

firm Point-Topic, on the other hand, indicated that the digital subscriber line (DSL) penetration rate by 2002 was about 9%, second only to the Republic of Korea.[86]

d. India

Population	1,027,015,247	(2001)
GDP per capita ($)	460	(2001)
Main lines per 100 inhabitants	3	(2001)
Main lines per 100 households	17	(2000)
Number of mobile phones per 100 inhabitants	0.63	(2001)
Number of Internet hosts per 10,000 people	0.81	(2001)
Literacy rate, Total (%)	55	(2003 estimate)
Literacy rate, Female (%)	41	(2003 estimate)
Literacy rate, Male (%)	68	(2003 estimate)
Education expenditure as a percent of GNP	2.9	(1999–2000)
Number of years of compulsory schooling	8	(1998)
Number of students per teacher, primary school	43	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. In May 1998, the Prime Minister formed a National Taskforce on Information Technology and Software Development to formulate a long term National IT policy for the country, and to remove impediments to the growth of the ICT industry. The main objective was to help India emerge as an IT software superpower. The Taskforce submitted three key reports suggesting various measures to build India's ICT industry and proliferate use of IT in the country. The three reports were (i) IT Action Plan I (Software), (ii) IT Action Plan II (Hardware), and (iii) IT Action Plan III (Long Term National IT Policy).

[86] See http://www.nici.nat.gov.tw/ 27 March 2003.

In IT Action Plan Part-III, the Long Term National IT Policy outlines the 108 recommendations of the IT Action Plan. Part-I emphasizes the Policy Framework required for creating an environment for the accelerated flow of investment into the IT sector, with specific orientation toward the software industry. The Information Technology Action Plan, Part-II, furnishes 84 Policy instruments for the development, manufacture, and export of IT Hardware. The Task Force maintained that the software industry and the hardware industry are two sides of the gold coin representing India emerging as a global IT super power. The success of one, whether it is export of software of $50 billion by the year 2008, or the IT penetration drive for realizing IT for all by 2008, depends on the concomitant success of the other. In addition, many of the Indian States and Union Territories have developed their own ICT Policies.[87]

ICT in Education. The Department of Education released the National Curriculum Framework for School Education in November 2000, following extensive consultation across the country. The Framework provides guiding principles for reshaping the curriculum for schools.

The Curriculum Framework recognizes that information technology has begun to challenge what schools try to teach and the whole basis of assessing the knowledge and skills that students acquire. It accepts that the process of education can no longer ignore the social and psychological impacts of technology. It also acknowledges the possibilities opened up by sharing information on a global basis. All this affects the way people think and learn and therefore has profound implications for education at all levels.

The Curriculum Guide and Syllabus for Information Technology in Schools is an immediate offshoot of the Curriculum Framework. Designing a course of study that would integrate information technology into schooling is no easy task, because of the pace of change in the technology. There are certain basic principles, however, that are more constant; they define the prospect of this emerging area in education, and their implications have been elaborated in the Curriculum Framework. Together, they underscore the urgency for:

[87] Global Internet Policy Initiative India at: http://www.gipi.org.in/ICT.html.

- Formulating plans to integrate computers into the curriculum, and beyond, for making IT a part of the schooling process;
- Creating a framework to enhance learning opportunities in the electronic environment across the curriculum;
- Providing access to global information sources;
- Providing professional development opportunities to teachers that would enable them to act as facilitators of learning;
- Designing flexible curricular models, which would embrace inter-disciplinary and cross-disciplinary thinking; and
- Developing attitudes that are value-driven, not technology-driven.

The Department's initiatives in this area are a response to these urgent tasks. The set of assumptions upon which the Curriculum Guide and Syllabus for IT in schools is based is the vital link between this document and the Curriculum Framework. The document outlines the IT-related competencies for children up to class 10 (i.e. at the end of general education), suggests ways of assessing those competencies, identifies desirable skills and activities to achieve them, enlists provisions for children with special needs, and proposes desirable competencies for teachers. It also suggests areas in the curriculum into which the technology can be integrated.

Best practices ... World Links in India

The World Links India Program was initiated in January 2002 with the training of thirty master trainers from Delhi and Karnataka. As part of Stage I of the World Links India Program, World Links targeted 32 rural and underserved government schools in Delhi and Karnataka, partnering with the Kendriya Vidyalaya and Navodaya Vidyalaya school systems in Delhi and the Government of Karnataka schools in Karnataka. In its first year of program implementation, World Links trained 200 teachers in Phase I of the World Links teacher professional development program (Introduction to the Internet for Teaching and Learning).

In 2003, World Links expanded its India program to reach a total of 80 rural and underserved government schools in Delhi, Haryana, Karnataka, and Andhra Pradesh. In addition to expanding into new schools, World Links will be deepening its presence in existing program schools through the introduction of Phase III of its teacher professional development program (Curriculum and Technology Integration). World Links is also introducing its school-based telecenter concept in 5 schools in Mumbai.

Current Situation. Despite India's reputation as a software factory and with its very capable IT firms, Internet connectivity is highly variable between states, cities, and regions. The national backbone still does not function at high capacity in a seamless fashion; interconnection between operators is not easy, broadband connections are scarce, and the technology is more often than not obsolescent as compared to North America and more developed Asian and European countries. Even large firms have difficulty in moving files over the Internet between major locations such as Mumbai, Chennai, and Delhi. The technical policies and regulations governing telecommunications are still not as effective as they could be, and there remain strong irritants to smooth development, despite the government's strongly worded declarations for a fully liberalized and competitive telecommunications environment. For example, the spectrum management authority still insists on approving and licensing the ISM band,[88] which is normally free and open everywhere else in the world. Elsewhere, the liberalization of these frequencies has led to such innovation as the IEEE 802.11 set of standards for efficient and inexpensive local communications.

For the consumers and small businesses, there are encouraging developments. Key Indian ISPs, such as those owned by the Tatas, the Bharti group, and Satyam Infoway, are commencing operations on WiFi hotspots in India. Satyam Infoway has launched a WiFi service in the airports of New Delhi and Chennai for the equivalent of less the $1.50

[88] The ISM radio bands were originally reserved internationally for non- commercial use of RF electromagnetic fields for industrial, scientific, and medical purposes. In recent years they have also been used for license-free error-tolerant communications applications such as wireless LANs and Bluetooth.

per hour; WiFi cards can also be rented. The Bharti group, which already has broadband DSL offerings, will augment this service with WiFi boxes for the equivalent of less than $70. This package is targeted at residential users; other targets include conference and trade show venues, like Pragati Maidan in New Delhi. India's version of Starbucks, the Barista café chain, has 15 WiFi-enabled locations in Mumbai and Delhi, thanks to a link with Tata Teleservices, which has a stake in the coffee chain. Tata also plans to target distributor networks and warehouses.

Campuses like those of the International School of Business in Hyderabad and the Indian Institute of Information Technology in Bangalore already offer WiFi access for students. Intel has begun marketing PCs with its wireless Internet chip. Data Access is working on seamless migration from WiFi to GSM[89]-based Internet coverage. Systems integrators active in the business include Tulip IT Services and Convergent Data. Some hotels in India, like Le Meridien and the Taj hotels, already have WiFi installations. Offices of companies like Microsoft and Punjab National Bank are WiFi enabled. But the number of hotspots in India is at best a few hundred today. The number of laptops sold each year in India is a meager 16,000. Government rules also do not encourage wide-range WiFi deployment. And business models for revenue sharing are still being worked out.[90]

Given India's size and diversity, it is practically impossible to accurately depict the state of the nation's progress in introducing IT in education through a reading of the government policy document; many states and regions have launched ambitious programs[91] of their own. In addition, public-private sector partnerships have produced excellent results, such as Schoolnet India,[92] launched with the support of The Commonwealth of Learning and the Open Learning Agency, and patterned after Schoolnet Canada.

[89] GSM = Global System for Mobile communication.

[90] With contributions from Digital Review of Asia Pacific at http://www.digital-review.org.

[91] Government of India. Initiatives and Status on Human Resource Development in Information Technology in Union States and Territories. New Delhi.

[92] See http://www.schoolnetindia.com/.

e. Malaysia

Population	23,800,000	(2001)
GDP per capita ($)	3,700	(2001)
Main lines per 100 inhabitants	20	(2001)
Main lines per 100 households	88	(2000)
Number of mobile phones per 100 inhabitants	30	(2001)
Number of Internet hosts per 10,000 people	31	(2001)
Literacy rate, Total (%)	89	(2003 estimate)
Literacy rate, Female (%)	85	(2003 estimate)
Literacy rate, Male (%)	92	(2003 estimate)
Education expenditure as a percent of GNP	6	(1999–2000)
Number of years of compulsory schooling	11	(1995)
Number of students per teacher, primary school	20	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Malaysia's ICT policy is governed by the National IT Agenda (NITA), which has five strategic agendas: e-Economy, e-Public Service, e-Community, e-Learning, and e-Sovereignty. The Multimedia Super Corridor (MSC) is the embodiment of the policy, and it serves as a home environment for the country's major initiatives in each of the strategic thrust areas. The multimedia development applications are electronic government, Smart Schools, multipurpose cards, and Telehealth.

ICT in Education. The Ministry of Education sees ICT as a tool to revolutionize learning and to produce richer curricula, enhanced pedagogies, more effective organizational structures in schools, stronger links between schools and society, and the empowerment of learners. The concept of ICT in education, as seen by the Ministry of Education, includes three main policies:

- ICT for all students, meaning that ICT is used as an enabler to reduce the digital gap between the schools.
- The role and function of ICT in education is as a teaching and learning tool, as part of a subject, and as a subject by itself.
- Using ICT to increase productivity, efficiency, and effectiveness of the management system.

To support the country's ICT master plan, NITA, and to fulfill Vision 2020, the education system is in the process of being transformed, to create a new generation of more creative and innovative Malaysians who are adept with new technologies and able to access and manage the information explosion. ICT-enabled Smart Schools act as a catalyst in this process. The first phase of implementation began in 1999 with 90 schools. These constitute the pilots, a sampling of the array of schools in Malaysia. Broad deployment to the remaining schools started from January 2000 using a phased approach.

Smart Schools[93] are characterized not only by the introduction of technology, but also by their ability to deliver education in a better way. Government envisages that all schools will be converted into Smart Schools by the year 2010, and in its 2001—2005 Prospects report, it committed to expand the Smart School concept to 8,000 primary and secondary schools at a cost of 401.1 RM[94] as part of its Flagship Applications package in the MSC. In addition, it allocated 945 million RM[95] for computers for rural schools in the period 2001—2005.[96]

Multimedia technologies will create the enabling infrastructure for new teaching, learning, and management processes, for connectivity to external constituencies, and the educational network to link all Smart Schools. The three pilot applications are teaching learning materials, a more accurate assessment system, and an integrated management system. Other ICT-related projects involve the pre-service and in-service training of teachers, along with the training of school administrators and other school staff. Innovative projects, such as the use of electronic books and e-learning, are also being piloted.

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[93] ADB funded the pilots in a $40 million loan to Strengthen Malaysia Education in 1997.

[94] $105 million equivalent as of February 2004.

[95] $250 million equivalent as of February 2004.

[96] Abas, Gazali. 2001. New Trends in ICT. Presented at ITU-Waseda University Workshop for Regulators and Policy-Makers, Waseda University Tokyo, Japan, 13-24 November.

In addition, nongovernment agencies are very much involved in the drive to introduce ICT into schools. The Chinese Smart Schools project aims to set up computer laboratories in more than 100 selected Chinese stream primary schools throughout the country. There are also Private Smart Schools, incorporating multimedia technology and worldwide networking in addition to using ICT as part of the teaching-learning environment and as a subject in its own right.

The Ministry is committed to utilizing the following multi-prong strategies to ensure that the objectives of ICT in education are achieved:

- The preparation of sufficient, up-to-date, and tested ICT infrastructure and equipment for all educational institutions.
- The introduction of ICT curriculum and assessment, and emphasis on integration of ICT in teaching and learning.
- The upgrading of ICT knowledge and skills in students and teachers.
- Increased use of ICT in educational management.
- The upgrading of the maintenance and management of ICT equipment in all educational institutions.

Current Situation. According to the report *Creating a Development Dynamic, Final Report of the Digital Opportunity Initiative of July 2001* by Accenture and sponsored by the United Nations Development Programme (UNDP) and the Markle Foundation, the intent behind Malaysia's MSC has been to create a high-tech environment and infrastructure that can attract national and international investors and create spill over effects in the rest of the Malaysian economy—allowing it to leapfrog its neighbors to become Southeast Asia's leader in information technology. Its aim has been to replicate the conditions that underpinned the economic success of Silicon Valley, and also to use this as a starting point to develop spin-off applications intended to transform major sectors of society through the use of ICT: education (smart schools, distance university), healthcare (telemedicine), government (paperless administration), commerce (electronic commerce), and manufacturing (electronic processes).

Malaysian was one of the first developing countries to attempt to replicate the US Silicon Valley model. In its attempt to move the technology sector to attract domestic and foreign private investment,

the government invested in creating what was expected to be a world class physical and information infrastructure. The MMC is a $40 billion initiative, which serves as the backbone for the country's information superhighway. The network is supported by a high-speed link (10Gb/s network), which connects the MSC to Japan, the Association of Southeast Asian Nations (ASEAN), the US, and Europe. The network is also capable of supporting extensive public, education, and business applications.

A strong emphasis has been placed on the expansion of telecommunications infrastructure and the telephone penetration rate as a measurement of the ICT readiness of the country. The telephone penetration rate rose from 16.6% to 23.2% between 1995 and 1999, while fixed lines in rural areas rose from 5.2% in 1994 to 11% in 1999. The country aims to establish an infrastructure with 25 Internet access points, 25 mobile phones, and 50 fixed lines for every 100 people within the next 5 years. In addition, other supporting infrastructure, such as power, transportation, airports, office buildings, and extended business areas, are being developed to enhance the primary infrastructure of the country.

Beyond infrastructure, the Malaysian government provides attractive tax incentives for world-class technology-led companies to participate in the MSC initiative. Most importantly, it launched actions to provide a well-educated work force with relevant skill levels ranging from technical to research—since the MSC implies an enormous demand for IT skills that Malaysian society is currently unable to provide.

To address skilled labor shortages in all industries, education institutions such as the National Institute of Public Administration and the Multimedia University are developing curricula to better prepare the Malaysian workforce for the e-economy. In addition, to meet demands for knowledge workers, Malaysia offers unrestricted and user-friendly work permit policies for foreign knowledge workers. At the same time, the country has made several efforts to increase ICT literacy because widespread computer illiteracy among the general population is viewed as inhibiting the diffusion of ICT.

UNESCO reports that Malaysia is making every effort to become a knowledge-based economy. "Vision 2020", Malaysia's long-term strategy, calls for sustained, productivity-driven growth, possible only with a technologically literate, critical-thinking workforce that is prepared to participate fully in the global economy of the 21st century.

At the same time, Malaysia's National Philosophy of Education calls for "developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally, and physically balanced and harmonious."

f. Philippines

Population	77,131,000	(2001)
GDP per capita ($)	910	(2001)
Main lines per 100 inhabitants	4	(2001)
Main lines per 100 households	20	(2000)
Number of mobile phones per 100 inhabitants	14	(2001)
Number of Internet hosts per 10,000 people	3.9	(2001)
Literacy rate, Total (%)	96	(2003 estimate)
Literacy rate, Female (%)	96	(2003 estimate)
Literacy rate, Male (%)	96	(2003 estimate)
Education expenditure as a percent of GNP	4	(1998–1999)
Number of years of compulsory schooling	7	(2000)
Number of students per teacher, primary school	35	(1998–1999)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The Information Technology and Electronic Commerce Council (ITECC) was formed in 2000 in recognition of the high growth potential of ICTs. It is chaired by the President of the Philippines and is the country's highest policy-making body. Through ITECC's coordination, sector initiatives are nurtured in the line ministries. However, the allocation of responsibilities between departments is fragmented and at times confusing, and frequently there is little money to support plans. ITECC has produced the ePhilippines vision, which intends to make the Philippines an e-enabled society where citizens have access to technologies that will provide quality education, efficient government service, greater source

of livelihood, and a better way of life. The ePhilippines vision is anchored on five equally important strategies. These are:

- Developing the country as a world-class ICT services provider.
- Providing government services to stakeholders online.
- Providing affordable Internet access to all segments of the population.
- Developing an ICT enabled workforce.
- Creating an enabling legal and regulatory environment.

To focus on themes and marshal public and private sector resources involved in IT, ITECC has created five committees: Business Development, eGovernment Implementation, Information Infrastructure, Human Resource Development, and Legal and Regulatory. Each committee is co-chaired by a representative of the government and one from the private sector. The government co-chair comes from the government agency whose mandate and functions closely relate to the focus areas of the committee.

The focus areas of the Information Infrastructure Committee are:

- Identifying priority hubs for network development.
- Developing a plan to establish Telecenters around the country.
- Developing incentive programs for private sector participation in non-commercially viable areas.
- Undertaking project study on bandwidth requirement plan.
- Reviewing and resolving interconnection issues.
- Reviewing, updating, and revising frequency management policies and practices.

ICT in Education. Within the ePhilippines vision, the Human Resources Development Committee is responsible for developing human capital. Its focus areas are:

- Developing policy and programs on e-learning.
- Developing guidelines on enhancement of Basic Education.

- Developing programs on government/private sector initiatives in increasing supply of IT skills.

As of November 2003, there had been no significant budgetary commitment to achieve these goals, and the various agencies are open to donor funding to help launch their activities.

Current Situation. A major effort will be required because, although the national telecommunications infrastructure is more or less adequate, marketing and business practices in the sector prevent a more optimal utilization of the national network and of local exchanges. Access, even in major Internet cafés, such as in Megamall in Ortigas and in the International Airport, is unreliable and slow, and the local version of ADSL is extremely expensive in relation to incomes. It is also founded on relatively obsolescent technology. Outside of Metro Manila and a few major centers, connectivity above 28.8 kilobits is generally not available.

g. Sri Lanka

Population	19,104,000	(2001)
GDP per capita ($)	850	(2001)
Main lines per 100 inhabitants	4	(2001)
Main lines per 100 households	19	(2000)
Number of mobile phones per 100 inhabitants	4	(2001)
Number of Internet hosts per 10,000 people	1.2	(2001)
Literacy rate, Total (%)	92	(2003 estimate)
Literacy rate, Female (%)	90	(2003 estimate)
Literacy rate, Male (%)	95	(2003 estimate)
Education expenditure as a percent of GNP	3.1	(1998–1999)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	28	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Given government's commitment to achieving its ambitious e-Sri Lanka Strategy, this country may become a benchmark for other developing nations within the next 5 years. Government has recently established the ICT Agency with financial support from the World Bank. It is more formally known as the Information and Communications Technology Agency of Sri Lanka. It brings together public and private resources to orchestrate all activities in its key result areas:

- Aggressively build the necessary connectivity infrastructure throughout the country to connect villages and towns to the world.
- Create the enabling environment, including the enactment of regulatory reform together with the acceleration of enabling laws for e-government and e-commerce.
- Develop human resources at multiple levels to support national development.
- Modernize the public sector and deliver citizen services through e-government constructs.
- Bridge the digital divide with applications aimed at poverty reduction and social development.

Sri Lanka was one of the first countries in Asia to adopt a very dynamic enabling policy and regulatory framework in close partnership with Canada's Department of Communications as far back as 1995. It has liberalized all sectors of telecommunications, and introduced competition wherever possible and viable to do so. As a result, international communications costs, which 5 years ago were among the highest in the world, have become the most competitive in Asia, and this is one of the few countries where voice over Internet protocol (VOIP)[97] is legal to stimulate low-cost communications.

ICT in Education. The National Policy on Information Technology in School Education (NAPITSE) affirms the commitment of the government to providing state-of-the-art knowledge in IT to Sri Lanka's younger generation, preparing them to face the challenges

[97] VOIP = Voice Over Internet Protocol.

in the 21st Century. This policy provides a clear vision and direction in making this a reality. It is supported by an action plan and a 6-year strategic plan for 2002 to 2007, which is in the form of a rolling plan, undergoing periodic changes with necessary academic and professional inputs incorporated as and when necessary. The action plan will focus on (i) using IT in education (learning and teaching), (ii) using IT in management of the education system Vision, (iii) empowering a new generation of Sri Lankans with information and communication technology, and (iv) facilitating the planning, implementation, and sustenance of information technology education in schools to enhance students' learning and the quality of teaching.

The NAPITSE has the following overarching goals:

- Envisage and foresee the future global challenges in IT education and lay the foundation for appropriate human resource development to meet such challenges.
- Create conditions enabling the effective use of IT as a tool in learning and teaching at all levels in the general school education.
- Provide "information literacy" for all school leavers.
- Create conditions for effective involvement of the school system in lifelong education of citizens.
- Create an information literate population of teachers and teacher educators.

To accomplish these goals, the following objectives would be achieved under the following four major strategic themes:

- **Curriculum development** aims to (i) introduce, sustain, and enhance IT involvement in general education in schools and create opportunities for IT-based learning and teaching; and (ii) introduce IT into pre-service and in-service teacher development and training programs, and create opportunities for system-wide professional development of teachers.
- **Human resource development** aims to (i) provide necessary education and training to all teachers in government schools,

making them competent in using IT for teaching purposes; (ii) upgrade officers in the education system to handle IT-related activities competently and with ease; and (iii) create opportunities for the out-of-school population to utilize resources in school-based IT resource centers, thus creating an environment for community learning.

- **Physical/Infrastructure development** aims to (i) allocate and distribute optimal resources in an equitable manner to meet the learning needs of students and learning/teaching requirements of teachers; (ii) set up an Information Technology Education Resource Centre (ITERC) at the national level, nine ITERCs at the provincial level, and zonal-level ITERCs for teacher training/development; (iii) establish an IT education laboratory at the National Institute of Education to improve curriculum development; (iv) establish an ITERC at the Centre for Professional Development of Management of Education; (v) dedicate a National College of Education (NCOE) for development of IT teachers under pre-service teacher training; (v) provide innovative means of training through activities, such as mobile training laboratories; (vi) set up a Multimedia Education Software and Web Development Centre.
- **Support initiatives development**. As IT undergoes rapid changes in terms of technology and usage, the support initiatives will ensure that such changes are incorporated in the learning process of pupils, without having to wait for the curriculum changes. The following are the envisaged support initiatives: (i) establish IT school clubs; (ii) encourage preparation of Web sites for schools; (iii) encourage teachers to own personal computers; (iv) design, develop, and maintain a web site for the Ministry of Education and Higher Education to assist the school system in e-learning and information management; (v) convene appropriately time-framed IT education research and development conferences/ colloquia; (vi) facilitate the establishment of a professional body for those who are involved in IT education in schools; (vii) establish a fund to support innovative approaches and creative initiatives for school IT education development; (viii) initiate an award scheme to encourage educators to promote

innovative IT education; and (ix) forge strategic partnerships with other government institutions, Sri Lankan Missions abroad, foreign missions in Sri Lanka, national and international nongovernment organizations (NGOs), and the private sector to extend the coverage of IT education, and promote and enhance the quality of IT education in the school system.

Current Situation. In seeking to accomplish its objectives within e-Sri Lanka, the Government concluded arrangements for the following major investments during 2003—2004.

- **e-Sri Lanka.** This project is financed by a loan from the World Bank in the amount of $50 million**.** The objective of the project is to promote effective use of ICTas an enabler for development throughout key sectors of the economy. The ICT Agency will be the lead government institution with regard to the creation of a digitally advantaged Sri Lanka. The Agency functions will be carried out within the framework of a defined strategic roadmap that identifies the needs for national connectivity, the passage of relevant legislation, development of human resources, establishment of e-governance, market creation, and promoting information dispersal and transparency.[98]
- **Improving Relevance and Quality of Undergraduate Education.** Another project financed by a loan from the World Bank in the amount of $40.3 million.
- **Distance Education Modernization.** Project financed by a loan from ADB in the amount of $64 million. The Project aims to provide a full range of high quality courses for secondary school graduates who lack access to conventional universities by setting up a national network of more than 100 Telecenters plus affiliated facilities in existing or proposed community and university locations reaching the most remote areas of the country. The project will help the government implement e-Sri Lanka and related strategies by modernizing the post-secondary education system, especially

[98] See http://www.esrilanka.lk/.

through the introduction of high quality distance education and the promotion of public/private partnerships to reduce pressure on public sector enrollment. A major component, the DEPP, will oversee procurement of computer and network equipment, software licenses, specialized learning and content creation services and products, subscriptions to learning services, electronic libraries, and related maintenance. Some specialized transmission and receiving equipment to provide seamless broadband access to online education nationwide for all qualified member institutions will also be procured. The project will upgrade existing amenities and establish new facilities on selected campuses of the Open University of Sri Lanka. The network will be Asia's first educational network with initial capacities of 100 megabit trunks between major centers, and 10 megabits (fully scalable) to lesser-populated regions. Projected demand calls for full system upgrading to 100 megabits within 5 years.

The Ministry of Education and Higher Education understands that Sri Lanka is lagging behind many countries of comparable economic growth and social environment in the development of IT. Computer Resource Centers (CRCs) were introduced with the support of the ADB. This network now includes 73 CRCs across the country, providing computer literacy to students during school vacations and during the period after exams.

However, integration of IT or computer education with the formal curriculum in school education has not yet taken place. IT is not yet offered as a subject in the school curriculum. Nevertheless, there are some activities being run through the "activity room" concept in schools. Also, in the business studies syllabus for junior secondary level, there is a marginal involvement of IT.[99]

[99] Compiled with documents from Ministry of Education and Higher Education, and UNESCO.

h. Thailand

Population	63,584,000	(2001)
GDP per capita ($)	1,870	(2001)
Main lines per 100 inhabitants	9	(2001)
Main lines per 100 households	36	(2000)
Number of mobile phones per 100 inhabitants	12	(2001)
Literacy rate, Total (%)	96	(2003 estimate)
Literacy rate, Female (%)	95	(2003 estimate)
Literacy rate, Male (%)	98	(2003 estimate)
Education expenditure as a percent of GNP	5.2	(1999–2000)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	21	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

Integrated Policy. The National ICT plan recognizes that a massive program to introduce computers, multimedia, and distance education facilities to all state schools is imperative. This drive must be accompanied by the development of suitable courseware specifically designed for electronic delivery.

The government also recognizes that it is vital to view ICT as a tool for achieving broader national objectives, both social and economic, rather than regarding ICT as merely an end in itself. The policy was formulated in recognition of the vast potential of ICT to enhance economic activity, democratic principles, and wealth distribution, and to provide access to social benefits such as education across every region of the country.

Education in Thailand is undergoing a reform process led by the1999 Education Reform Act. In the context of this reform, a national policy was formulated by the newly-established National Institute for Technology for Education. Initiatives include plans to:

- Give all teachers, college lecturers, professors, school children, and college students opportunities to learn to use ICT. The

goal is to employ ICT as an enabling tool to access information and gain knowledge through self-paced learning, or through IT interactions with teachers and fellow students.

- Link schools, colleges, universities, and libraries electronically to provide students, teachers, and lecturers an enriched environment in which distant resources can be made available in remote areas.
- Make full use of ICT and distance education to meet the needs and aspirations of all citizens for continuous education and skills upgrading without regard to age, profession, distance, or geography.

The goals of the National School Information Program are to (i) introduce at least one computer per 80 primary school students and one computer per 40 secondary school students within 5 years; (ii) allocate, on a continuous basis, an annual budget of 1,000 million Baht[100] to acquire ICT equipment such as PCs, communication modems and, where appropriate, satellite receivers and multimedia equipment—the amount should be sufficient to equip state schools with up to 30,000 PCs each year; and (iii) connect all universities and colleges, and later on, secondary schools, to the Thaisarn/Internet.

Additional, more specific goals included:

- Ensuring all teachers and students to be IT and Internet literate by the year 2002.
- Producing 250 titles of academic software and content annually.
- Funding worth 500 million Baht per annum to various communities for content development, as well as a budget for localizing 2000 titles of useful foreign content.
- Achieving a PC density target of 1:20 in secondary schools and of 1:40 in primary schools, as well as considerable investment in LAN and standardized administrative software.

[100] Equivalent to $26 million as of February 2004.

- Providing IT for education and professional development to the under-privileged, the disabled, and those looking for lifelong learning.
- Providing adequate radio frequencies for the education sector.
- Investing annually on IT research and development for education of no less than 400 million Baht.

The UniNet supports and connects all universities and higher education institutions in Thailand. The SchoolNet project provides and manages a network for schools. By early 2003, it was expected that some 4,180 secondary schools would participate in Schoolnet.[101]

Less-Developed Countries: East and Central Asia Region

Less-developed countries include those that may have national policies, but inadequate human, financial, and material resources to implement their ambitions. Leadership in these countries also may not consider ICTs a priority in government, or for the support of economic development and business. Some of these countries may not have a formal policy framework for ICT. Others may adopt regional policy statements—such as eASEAN, and may be trying to catch up through pilot projects sponsored by various NGOs and donors. In some instances, national policies are not appropriate to the capacity of the country. Other countries have drafted ICT or education policies, but lack realistic work plans.

Countries in this group generally lack the budgets and perhaps the political commitment to implement policies and work plans needed to empower their populations. The most common barriers are the quality, affordability, and coverage of telecommunications infrastructure, and the very limited use of ICT applications. In small Pacific island states such as the Maldives, submarine telecommunications cables are lacking and connectivity is available only through expensive satellite links. The same issue affects landlocked countries like Afghanistan, Tajikistan, Kyrgyz Republic, Uzbekistan, Turkmenistan, Kazakhstan, Azerbaijan, Bhutan, Nepal, and Mongolia. In these coun-

[101] UNESCO.

tries, where high-capacity cables do exist, throughput is often dependent on a neighboring country that controls the international link.

In many of these countries, schools often will have received donated computers from well-meaning NGOs, but often they are not functioning properly, and there is little if any local technical support or spare parts. ICT training offered by public sector schools is most often obsolescent. Even courses available from private sector institutions are frequently far below the standards expected in the developed world, since there is no quality control or institutional accreditation process. ICT training in schools, where it is available, is often introduced only as a distinct subject, rather than as an integral part of the curriculum. Sometimes, teacher training in information technology has just begun, mostly focusing on computer literacy in basic software, such as standard office applications.

The private sector has begun to facilitate or stimulate the use of ICT in education in these countries with a view to satisfy its future workforce needs, or as part of a corporate philanthropic initiative. Intel, Cisco, Hewlett Packard, Sun Microsystems, IBM, Siemens, Nortel Networks, Coca Cola and others have made significant efforts in this area.

Clearly, most of these countries require intensive help in policy and master plan development; in strengthening their infrastructure and connectivity; in teacher training; and in use of ICTs in classrooms. While the most common problems still relate to infrastructure and telecommunications development, further challenges include complexities of a linguistic nature (most ICT-related software and contents are in English and use latin characters); disparity in the accessibility of ICTs between urban and rural areas; lack of motivation and technophobia among teachers; shortage of trained teachers and champions in the system; and few local best practices and qualified human resources on which to build a new knowledge economy.

The countries in this group are clustered by region for convenient reference: (i) East and Central Asia Region, Mekong Region, Pacific Region, South Asia Region and Southeast Asia Region.

The countries in the East and Asia Region included Azerbaijan, Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, Turkmenistan, and Uzbekistan.

a. Azerbaijan

Population	7,830,746	(2003 estimate)
GDP per capita ($)	640	(2001)
Number of mobile phones per 1000 people	111	(2001)
Number of Internet hosts per 10,000 people	2	(2001)
Literacy rate, Total (%)	100	(1995)
Literacy rate, Female (%)	100	(1995)
Literacy rate, Male (%)	100	(1995)
Education expenditure as a percent of GNP	4.3	(1999–2000)
Number of years of compulsory schooling	11	(2000)
Number of students per teacher, primary school	19	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. While the government is responsible for the overall management and execution of all aspects of ICT policy, it has selected the State Student's Admission Commission (SSAC) to be responsible for the development and application of the national ICT strategy. SSAC is to be the executing agency of this initiative, with strong support from UNDP. Thus, in addition to handling student admissions in higher and secondary special schools, SSAC will address all issues that involve ICT nationally, and actively represent Azerbaijan in international ICT events.[102]

In February 2003 the President of the Republic of Azerbaijan signed the Decree on "The Adoption of National Information Communication Technologies Strategy (2003—2012) for development of the Republic of Azerbaijan." The National Strategy authorizes the preparation of a National Information and Communication Technology Strategy that reflects the government's commitment to

[102] See http //www.nicts.az:8101/english/7.html.

ICTs. The strategy will take into account society's requirements, advanced experience globally, and facilitate Azerbaijan's integration into the world community. The strategy's objectives are to:

- Assist the country's democratic development,
- Formation of a unified information zone in the country,
- Provide for the country's information security,
- Reinforce the country's economic, social, and intellectual potential,
- Create the required organizational, technological, and legal environment,
- Create equal opportunities for all sectors irrespective of ownership forms,
- Fully integrate the country into the world community, and
- Establish favorable conditions for transition to an information-intensive civil society by 2011.

The strategy will be implemented in three phases. Phase 1 will cover the period 2002—2003, Phase 2 the period 2004—2007, and Phase 3 the period 2008—2011. Projects to be carried out during the 10-year period include:

- Creating and developing a legal basis for the enhancement of information structures and adoption of State standards.
- Facilitating the wider use and application of science in ICT.
- Creating a favorable environment for setting up small and medium-sized enterprises that produce internationally competitive products and services.
- Enhancing an information infrastructure in education, monitoring education, and DL.
- Developing Internet and information services.
- Encouraging the wider use of the Azerbaijan language and alphabet and create a national information resource.
- Establishing and developing regional and district information centers.

ICT in Education. It appears probable that ICT in education policy will be formulated as part of the National ICT policy, expected to be released by mid-2004.

Current Situation. UNDP has supported the establishment of the Sumgait Computer Center for Training and Information and Telecommunication Services, and the Nakchivan Computer Center for Training and Business Information Services, in partnership with the Baku Scientific and Training Center (BSTC) of "Informatics." BSTC is recognized as the main training and research institution of the State Committee of Science and Engineering of Azerbaijan, offering multi-level training for various ages and professional groups. BSTC conducts IT training for all Azerbaijani post-graduate students in medicine, agriculture, and humanitarian sciences. It has a special department dedicated to training school children, and under a special initiative of the Ministry of Labor and Social Protection, provides discounted training for displaced persons and refugees. The staff of BSTC have developed a number of software applications for broader use in the state and private sectors. The project's overall success led to branches being established in Sumgait and Nakchivan, as well as 11 other regions of Azerbaijan. Additionally, the Azerbaijan Technical University has a faculty of "Information and Computing techniques" which offers advanced training in ICT.[103]

A new Computer and Internet Center of the Western University was established in cooperation with the United States Information Agency's (USIA) Internet Access and Training Program (IATP). E-mail, Internet access, and training for alumni of the USIA educational exchange program, scholars, intellectuals, and students are being provided. In the long-term, IATP is to set up a number of sites with LANs and computers for e-mail and Internet access across the country.

[103] See http://www.ndu.edu.az/.

b. Kazakhstan

Population	16,763,795	(2003 estimate)
GDP per capita ($)	1,500	(2001)
Number of telephones per 1000 people	113	(2000)
Number of Internet hosts per 10,000 people	7	(2001)
Literacy rate, Total (%)	100	(1995)
Literacy rate, Female (%)	100	(1995)
Literacy rate, Male (%)	100	(1995)
Education expenditure as a percent of GNP	4.4	(1997)
Number of years of compulsory schooling	11	(2000)
Number of students per teacher, primary school	19	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. According to a report by *Interfax*, the Government of Kazakhstan approved in July 2003 regulations guiding the Kazakh Agency for Information Technology and Communications.[104] The agency is empowered to implement state policy on information technology and communications. Its main tasks are to:

- Implement major state policies in information technology, conducting technical supervision and control;
- Regulate activities in the information and communications technology sector, and to participate in distributing radio frequencies;
- Set standards and issue certificates in the field of ICT;
- Create conditions for the communication services market to operate;

[104] See http://www.regulateonline.org/intelecon/2003/July_2003/A-Kazakhstan-030731.htm.

- Place state orders for scientific and research projects in this sphere; and
- Ensure international cooperation.

ICT in Education. In the report, *Higher Professional Education in the Republic of Kazakhstan at the Break of the Centuries* (Astana 2001), a history of education in the country is provided as well as an outline of future plans. Part 5 of the report, Content of Education and Instructional Strategies of the 21st Century, calls for the education sector to be a focus of information gathering and availability, and for use of high-tech information technologies to enhance the intensity and efficiency of educational processes.

Current Status. According to Actis Systems Asia, there were an estimated 201,000 regular Internet users in the country as of mid-2001. Increasing competition was resulting in better and a wider range of service at more attractive rates and conditions.

There were six major commercial ISPs in the country providing access to the Internet through dial-up accounts and leased lines. The competition among ISPs is not intense; however, demand for Internet connection is growing, and more companies are expected to enter the market. At least three cyber cafes are operating in Kazakhstan, offering public access to Internet at the equivalent of about $2 per hour. Dedicated lines can be leased from Kazaktelecom and some big private companies (Nursat, etc.). In 2000, only 5.5% of families in the larger cities of Kazakhstan had home PCs, and only one third of these computers had a modem allowing Internet access.[105] However, an Actis Systems Asia (online) study in November 2000 sponsored by InfoDev forecast a doubling of these levels by the end of 2002. The study survey found that three major issues were affecting Internet users:

- The high price of Internet access (73.7% of all respondents),
- The absence of, or poor, telephone lines (63.5%), and
- The lack of interesting resources in the Kazakhstan part of the Internet (59.4%).

[105] InfoDev funded the project on the Kazakhstan Gateway (Grant No. CG 003).

The Multilateral Investment Guarantee Agency issued $14.3 million of guarantees for loans for a digital cellular telecommunications network in Kazakhstan. Project documents state that GSM Kazakhstan expects its number of subscribers to increase from 15,000 to more than a million by 2008. Kazakhstan has relatively strong penetration of fixed telephone lines, at over 11%. However, the country's infrastructure remains in a generally poor state, with only a small proportion of the switching system being electronic, and much of that is old. There is a high level of unsatisfied demand, with a 2-to-3-year waiting list. The national operator, Kazakhtelecom, has launched a program to modernize the country's telecommunications system. Of particular interest is the dramatic boom in mobile services that has occurred, with annual growth of nearly 200% recorded by mid-2002. This growth was still surging at a rate of more than 100% by end-2002.[106]

In education, particular importance is attached to studying foreign languages and developing student computer skills. In September 1997, the president of the country approved a state program aimed at computerization of the secondary education system. The higher education system is represented by 132 institutions, of which 59 are state-owned and 73 are private. Average tuition fees for bachelor's degree programs in Kazakhstan universities are equivalent to $800—900 per year. The number of students in the higher educational system as a whole increased by 1.3 times, mainly due to significant expansion of private education.[107]

[106] Compiled with documents from Multilateral Investment Guarantee Agency, and Global Information Inc.

[107] See http://www.bilim.kz/eng/education/default.asp?region=1&lang=0&id=659.

c. Kyrgyz Republic

Population	4,892,808 (2003 estimate)
GDP per capita ($)	310 (2001)
Number of telephones per 1000 people	78 (2001)
Number of Internet hosts per 10,000 people	9 (2001)
Literacy rate, Total (%)	100 (1995)
Literacy rate, Female (%)	100 (1995)
Literacy rate, Male (%)	100 (1995)
Education expenditure as a percent of GNP	5.7 (1998–1999)
Number of years of compulsory schooling	10 (2000)
Number of students per teacher, primary school	24 (1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

Current Situation. Little can be found in public sources on the level of use of ICT in education the Kyrgyz Republic. The World Bank Institute (WBI) began training activities there in 1993. Since then, over 1,500 have been trained at the national, regional, and international WBI workshops and seminars.

A distance learning program was launched in in 2000 in close partnership with the Swiss Government, the Open Society Institute, UNESCO, the Eurasia Foundation, and other international organizations. Kyrgyz State National University, the International University of Kyrgyzstan, the Academy of Management under the President of the Kyrgyz Republic, and Osh State University were selected as the primary pilot universities. After signing memoranda of understanding with WBI, these institutions were equipped with the necessary software and facilities for DL. Professors and technical staff of these universities participated in the WBI training programs. Currently, the pilot universities use DL to teach economics courses, and to participate in online discussions and lectures at universities in the Commonwealth of Independent States (CIS) and in other countries through a Virtual Learning Environment. In addition, the pilot universities organized "multiplication workshops" for other universities of the Kyrgyz Republic. A total of 29 universities have been trained through these workshops. Recently, two more universities——the Retraining Institute of the Kyrgyz State National University and

Kyrgyz-Russian Slavonic University—have been included in the DL program as pilot universities. A new concept of information technology in education was introduced and applied in the Kyrgyz system of education through the DL program.[108]

A disciplined program of economic reform, and a steady movement toward a market economy has seen the Kyrgyz Republic achieve strong growth in GDP, as well as other measures of a healthy and stable economy. This has resulted in the country attracting strong foreign investment and assistance of various kinds. The benefits have flowed to the telecommunications sector, which is being restructured in the final phase of an extensive privatization program. Although the country has been expanding and upgrading its telecommunications network since 1991, much work remains to be done. National telephone density was around 8% by end-2002, with a strong bias toward urban areas.[109]

d. Mongolia

Population	2,559,000 (2001)
GDP per capita ($)	430 (2001)
Main lines per 100 inhabitants	5 (2001)
Main lines per 100 households	24 (2000)
Number of mobile phones per 100 inhabitants	8 (2001)
Number of Internet hosts per 10,000 people	0.63 (2001)
Literacy rate, Total (%)	99 (2003 estimate)
Literacy rate, Female (%)	99 (2003 estimate)
Literacy rate, Male (%)	99 (2003 estimate)
Education expenditure as a percent of GNP	5.7 (1997)
Number of years of compulsory schooling	8 (2000)
Number of students per teacher, primary school	33 (1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

[108] Compiled from World Bank Country Assistance Strategy FY 2003—2006 for the CIS, and the World Bank Country Brief.
[109] Global Information Inc.

ICT Policy. In February 2000, the Mongolian Parliament adopted the "National Vision for ICT development of Mongolia up to 2010." This vision seeks to create a favorable environment and the conditions for citizens to participate fully in the new global knowledge society. Four overarching goals are incorporated in the National Vision:

- **Training**. Full utilization of ICTs in the curriculum and content at each educational level in order to introduce opportunities for the use of ICTs and to gain knowledge and skills in their utilization.
- **Hardware**. Supply of hardware to facilitate the conduct of training according to different levels of ICT development, and to provide free access to information.
- **Teaching staff**. Provide teachers the opportunity to advance their own career development in terms of their own knowledge and skills, and to stay current with the rapid development of ICTs.
- **Informationware**. Create and offer easy access to information services by establishing educational information databases and networks.

ICT in Education. Mongolia adopted the "ICT Action Plan of the Education Sector of Mongolia by year 2004." The Action Plan contains the following elements:

- Within basic education, the government will conduct training aimed at improving knowledge and skills of the most popular and commonly-used software, such as word processing, spreadsheets, information exchange, and communication.
- Starting in academic year 2002—2003, the curriculum of basic education will be revised to include a requirement that by completion of grade 8, students will have been taught at least 70 hours of "Informatics."
- Additionally, free access will be provided for students of secondary schools who do not have access to modern and well-equipped ICT training labs through a voucher system. Mobile labs will be set up for short-term training and information services for schools lacking modern ICT facilities.

- For upper-secondary, vocational, and technical education, opportunities will be provided to gain knowledge and skills in the use of the most popular software and latest applications, such as desktop publishing, Internet applications and e-mail, access to ICT applications, and search and use of necessary and available information.
- Model textbooks will be developed in "Information Sciences" for all levels of education.
- Pre- and in-service teacher education initiatives will be set up for staff in secondary schools in revision of contents and curriculum, and expansion of professional teachers' training activities. There will be a possible increase of professional teaching staff in information sciences by up to 50% by 2003, and up to 90% by 2007.
- Training will also be organized for teachers who want to use ICT in teaching their subjects, and favorable conditions will be nurtured to run ICT-supported training programs.

Current Situation. As part of its transition to a market economy, Mongolia committed itself to modernizing its telecommunications network and to steadily introducing new and advanced communications services. More than 50% of fixed telephone lines have been digitized. The country's telecommunications infrastructure, however, remains an obstacle to economic growth. The development of the telecommunications sector is central to the overall development of the country. An explosion in the mobile market saw an amazing 350% rise in the number of subscribers in 2001. Strong growth in the mobile market continued through 2002 and into 2003.[110] For more information, see *ICT in Education in Mongolia,* by Mr. B. Erdenesuren, Vice Minister of Ministry of Science, Technology, Education, and Culture, Mongolia.[111]

[110] Global Information Inc.
[111] High-level Seminar on Integrating ICT in Education, 18—22 February 2003.

e. Tajikistan

Population	6,863,752	(2003 estimate)
GDP per capita ($)	170	(2001)
Number of telephones per 1000 people	36	(2001)
Number of Internet hosts per 10,000 people	0.48	(2001)
Literacy rate, Total (%)	99	(2003 est.)
Literacy rate, Female (%)	99	(2003 est.)
Literacy rate, Male (%)	100	(2003 est.)
Education expenditure as a percent of GNP	2.2	(1999–2000)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	22	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. No published policy is currently available for ICT in education. The strategy for the telecommunications sector of Tajikistan was enunciated in a policy statement by the Minister of Communications at the World Telecommunications Development Conference (WTDC) in March 2002. The strategy comprises of four elements: institutional restructuring, liberalization, a universal service concept, and privatization. The principal objectives of the policy are to:

- Increase the availability, range, and reliability of telecommunications services, with primary emphasis on the satisfaction of demand in urban centers (business, government, and residential subscribers), as well as business, administrative, and residential subscribers in rural areas.
- Provide a clear, predictable regulatory framework that follows the principles of objectivity, transparency, non-discrimination, and proportionality.

- Liberalize the telecommunications sector by opening markets for entry by new operators and service providers, and by removing unnecessary barriers to entry.
- Apply tariff principles and structures that allow operators to generate an adequate return on capital.

Current Situation. As a result of the decline in economic growth after the civil war in Tajikistan, telecommunications infrastructure was neglected and has deteriorated. This presents a serious obstacle to economic and social development. Tajikistan's telecommunications network is arguably the least-developed of all the countries that emerged from the former Soviet Union. Starting with a telecommunications network that was near total collapse, government has begun the task of modernizing. The country had a telephone density of less than 4% by end-2002; less than 10% of the network was digital. The problems have been compounded by a series of natural disasters that left much of the cable network beyond repair.

The poor state of telecommunications services has certainly had a negative impact on business and government.[112] Poorly developed and not well maintained, many towns are not connected to the national network. There are international links by cable and microwave radio relay to other CIS republics, and by leased connections to the Moscow international gateway switch. Dushanbe is linked by Intelsat to an international gateway switch in Ankara, Turkey. The World Bank has approved a $10 million Education Reform Project, which includes components for communications and network infrastructure, computer equipment and software, and for specialized teacher training and development of learning materials.

[112] Adapted from Global Information.

f. Turkmenistan

Population	4,775,544	(2003 estimate)
GDP per capita ($)	1,100	(2001)
Number of telephones per 1000 people	80	(2001)
Number of Internet hosts per 10,000 people	3	(2001)
Literacy rate, Total (%)	100	(1995)
Literacy rate, Female (%)	100	(1995)
Literacy rate, Male (%)	100	(1995)
Education expenditure as a percent of GNP	4	(1991)
Number of years of compulsory schooling		Not available
Number of students per teacher, primary school	22	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

Current Situation. No published policy is currently available for ICT and ICT in education. Turkmenistan has a relatively underdeveloped telecommunications sector. Despite a telephone density close to 10%—which could be expected to provide a good base to build on, over the last decade or so the sector has remained relatively stagnant. Slow progress in the development of the private sector, and continuing state control over most economic activities have not been helpful to growth of telecommunication services. The Ministry of Communications continues to be both the policy maker and regulator for the telecommunications sector, suggesting that much remains to be done in terms of restructuring the industry.[113]

[113] Adapted from *2003 Information Highways and Telecommunications in Asia,* Volume 8: Global Information Inc. Available: http://www.gii.co.jp/english/pa14618_information_highways_v8.html.

g. Uzbekistan

Population	25,981,647	(2003 estimate)
GDP per capita ($)	450	(2001)
Number of telephones per 1000 people	66	(2001)
Number of Internet hosts per 10,000 people	0.08	(2001)
Literacy rate, Total (%)	99	(2000 estimate)
Literacy rate, Female (%)	99	(2000 estimate)
Literacy rate, Male (%)	100	(2000 estimate)
Education expenditure as a percent of GNP	7.7	(1996)
Number of years of compulsory schooling		Not available
Number of students per teacher, primary school	21	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

Current Situation. There is no published policy currently available for ICT and ICT in education. Uzbekistan has been struggling valiantly to bring its telecommunications system up to the standard found in developed countries, but with limited success. With a telephone density of less than 8% by 2002, growth in the sector has been stagnant. The country suffers from outdated and poorly maintained analogue exchange equipment. In 1996, in what was seen as a positive move, the government began inviting foreign telecom companies to invest in Uzbekistan. In 2000, Uzbekistan created a national telecommunications holding company, Uzbektelekom, in the first step toward privatizing the sector.[114]

[114] Global Information Inc.

Less-Developed Countries: Mekong Region

The countries included in this category are Cambodia, Lao People's Democratic Republic (PDR), Myanmar, and Viet Nam.

a. Cambodia

Population	13,440,000	(2001)
GDP per capita ($)	280	(2001)
Main lines per 100 inhabitants	0.25	(2001)
Main lines per 100 households	1.33	(2000)
Number of mobile phones per 100 inhabitants	1.66	(2001)
Number of Internet hosts per 10,000 people	0.46	(2001)
Literacy rate, Total (%)	70	(2003 estimate)
Literacy rate, Female (%)	60	(2003 estimate)
Literacy rate, Male (%)	81	(2003 estimate)
Education expenditure as a percent of GNP	1.1	(1999–2000)
Number of years of compulsory schooling	6	(1997)
Number of students per teacher, primary school	50	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. A national ICT policy has recently been proposed to Cambodia within the framework of the eASEAN Agreement. The four main areas of the proposed policy are: enhancing information infrastructure, developing human resources, developing local content, and creating the necessary legal and regulatory environment.

The Ministry of Posts and Telecommunications of Cambodia is the ICT sector policy-maker and regulator. It is also involved in one way or another in every telecommunications venture in the country, either as a provider or as a joint venture partner. Over the years, many proposals have advocated the corporatization of the telecommunications

arm of the Ministry and the creation of a "Telecom Cambodia," but no action has yet been taken.

ICT in Education. In February 2003, the Ministry of Education, Youth, and Sport (MoEYS), with support from UNESCO, organized a round-table to launch a project and to formulate policies and strategies for the use of ICT in learning and education for all in Cambodia. As a result of this national seminar, four specific policies were developed:

- ICT for all teachers and students, meaning that ICT is to be used as an enabler to reduce the digital gap between Cambodian schools and other schools around the world, especially schools in Asia and the Pacific.
- Emphasis on the role and function of ICT in education as a teaching and learning tool, as a subject in itself, and as part of other subjects. Apart from radio and television as a teaching and learning tool, this policy stresses the use of the computer for accessing information, communication, and as a productivity tool.
- Emphasis on using ICT to increase productivity, efficiency, and effectiveness of the management system. ICT will be extensively used to automate and mechanize work functions, such as the processing of student and teacher records, access to information via the Internet, communication between individuals and schools, EMIS, lesson planning, assessment and testing, financial management, and the maintenance of inventories.
- Promotion of education for all through distance education and self-learning—especially for deprived children, youth and adults who lack access to basic education—literacy and skill training, by integrating ICT with radio, television, printed materials, and other media.

In line with the above policy, MoEYS is attempting to reduce the digital divide by providing access to ICTs for learning and communication to all regional and municipal/provincial teacher training institutions, and then to schools across the country by 2015. This drive must be accompanied by the development of appropriate

strategies, namely, learning needs assessment and curriculum development, ICT networking, learning resources, research, and courseware, and teacher development and training.

Poor language skills and the lack of access to computers are two central challenges in the training of teachers in ICT. To address these and other problems, UNESCO, in collaboration with the Teacher Training Department in Phnom Penh, conducted workshops to train teacher trainers in ICT skills and their use in teaching and learning in 2003 in the project, Establishing the Effective Use of ICT in Education for All in Cambodia. At least one teacher trainer from each college in the country was trained in the initial workshop. Some of the initial trainees were used to train an additional 400 teacher trainers in a subsequent 16-day workshop. UNESCO prepared the course resources in Khmer, and provided a CD-ROM of teaching/learning resources. Pacific Tech donated a Graphic Calculator for Windows, and compiled other free educational software from the Internet that was not too dependent on language.[115]

Current Situation. MoEYS demonstrated its commitment to ICT in education by requiring all students in teachers' colleges to attend at least two hours per week in ICT courses, starting in 2003. The Ministry will continue to supply hardware and facilities for these colleges.[116]

The current situation in ICT may best be summed up by a contribution from Jacques Leslie in Operation Phnom.com in *Wired* magazine issue 7.11:

> *Even in favored areas, like Phnom Penh, electricity and telephones are erratic; everywhere else, they're nonexistent. Where international phone calls are possible, they cost $7 a minute. Internet links, established via satellite only two and a half years ago, can cost $10 an hour, and most of the nation's 2,500 Internet accounts belong to foreigners. Phnom Penh has somewhere between 10,000 and 50,000 computers, but the bulk of them was brought in by foreign diplomats and NGOs. Virtually all the software for sale in the capital is pirated.*

[115] Compiled from UNESCO, Bangkok.
[116] Adapted from MoEYS, 26 February 2003.

Khmers value education and pay a higher percentage of their income for it than citizens in nearly any other nation. Yet few students learn. Foreign aid and relief organizations underwrite almost all of Cambodia's spending on education, health, and infrastructure. Teachers, who are paid $20 a month (at best a quarter of a survival salary), either don't teach at all or charge students for supposedly free services. Many families cannot afford such fees. As a result one in three Cambodians is illiterate.

Cambodia still suffers from a dearth of technical people and teachers, three-fourths of whom were killed by the Khmer Rouge. The resulting shortage of educated people in their forties and fifties has deprived the country of its most socially useful citizens. Add to this the complexities of Cambodia's dominant language, Khmer—which it is at risk of losing and is highly resistant to digitalization. Phnom Penh's fledgling digerati have devised several font systems to reproduce the Sanskrit-based Khmer, but have not reached a consensus on the best one. Contributing to this problem is a flood of Thai and Vietnamese television programming over Thaicom satellites. Unlike their neighbors in Viet Nam, Khmers never embraced a Romanization system. Part of the reason is nationalism: some Cambodians fear that if Romanization catches on, their tottering culture will be further undermined. In the meantime, only Khmers who know a foreign language can use the Internet unaided.

Cambodia has some of the highest Internet prices in the world, and by far the highest tariffs in Southeast Asia. An entry level plan in Cambodia costs the user about $4 an hour, including telephone charges, more than eleven times what a much wealthier user in say, Singapore, would pay. To put Internet pricing in perspective, the average salary for a government employee, a teacher, or a policeman is around $20 a month. Some Internet cafés now offer a flat rate of $10 a month for unlimited use. That would prove interesting for regular users, but still limits services to the wealthy. While Internet access remains high priced, basic computer training in the capital is more easily accessable. Signs across Phnom Penh advertise PC training courses for Riel 1,000 (about 25¢) per hour, and these courses are very popular, especially among the young.

Although the government is aware of the benefits of the Internet and the need to provide public access in cities as well as in rural areas, Internet access is not its priority. The international community has played a key role in launching, providing, and nurturing the Internet use. The

Internet was introduced thanks to Canadian assistance. The main Internet access provider (Bigpond) started with Australian investment, and almost all initiatives to provide affordable Internet access to the public have been launched by nongovernment organizations.

With a per capita GDP of only $280, most Cambodians cannot afford even a telephone line. With prepaid mobile phone cards carrying denominations as low as $5, and used handsets available for as little as $20, mobile telecommunications are much more accessible for the average Cambodian.

Cambodia's unique recent history explains how it has leapfrogged older fixed-line telephone technology to move directly to wireless communications. Years of civil war destroyed most of the limited telecommunications infrastructure that was in service. By 1993, when mobile telephony was introduced, there were only 4000 fixed lines for a population of some 9.3 million. Today, more than 80% of the country's telephones are mobile.[117]

b. Lao People's Democratic Republic

Population	5,640,000	(2001)
GDP per capita ($)	330	(2001)
Main lines per 100 inhabitants	1	(2001)
Main lines per 100 households	5	(2000)
Number of mobile phones per 100 inhabitants	0.52	(2001)
Number of Internet hosts per 10,000 people	0.31	(2001)
Literacy rate, Total (%)	64	(2000 estimate)
Literacy rate, Female (%)	53	(2000 estimate)
Literacy rate, Male (%)	76	(2000 estimate)
Education expenditure as a percent of GNP	2.5	(1998—1999)
Number of years of compulsory schooling	5	(2000)
Number of students per teacher, primary school	30	(1999—2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

[117] With much appreciation to the ITU's Michael Minges for his contributions.

ICT Policy. There are virtually no ICT standards in Lao PDR. The public and private sector use several different conventions to integrate IT into organizational structures. Standardization of the Lao character set as well as software and hardware standardization for government ministries and agencies are required before substantial progress can be made.

ICT in Education. Selecting and introducing appropriate areas of science and technology into teaching, learning, and the curriculum, as well as giving more attention to scientific research to serve the needs of socioeconomic development, are among the most pronounced and immediate education policy goals.

The Ministry of Education (MoE) established an Information Technology Master Plan in Education Management, which has three major components:

- Establishing an EMIS in the Ministry for data collection and analysis.
- Linking the National University as well as provincial education services to the EMIS in order to facilitate information collection and other processes.
- Facilitating DL through the intranet system established.

MoE is currently implementing an intranet system spanning Vientiane and the provinces. The objective is to provide the MoE with an ICT system and to strengthen its education management capabilities. The MoE will be enabled to:

- Implement initiatives for the development of its technical infrastructure,
- Build human resource capacity and activities in technical, administrative, and managerial areas,
- Encourage the use of IT in education and training,
- Establish ICT tools and usage in provinces, universities, and others institutions,
- Promote services available via the intranet network to teachers, students, and other potential users, and

- Establish an integrated online EMIS and strengthen education management capabilities.

MoE is looking for foreign assistance to aid in building the capacity of teachers and staff, and improving curriculum and instructional materials.[118]

c. Myanmar

Population	48,363,000	(2001)
GDP per capita ($)		Not available
Main lines per 100 inhabitants	0.58	(2001)
Main lines per 100 households	2.69	(2000)
Number of mobile phones per 100 inhabitants	0.03	(2001)
Literacy rate, Total (%)	86	(2003 estimate)
Literacy rate, Female (%)	82	(2003 estimate)
Literacy rate, Male (%)	89	(2003 estimate)
Education expenditure as a percent of GNP	0.5	(1999—2000)
Number of years of compulsory schooling	5	(2000)
Number of students per teacher, primary school	33	(1999—2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

[118] For details see The Initiative of IT Network for Education and Training in Lao PDR.

ICT in Education. There is no published ICT policy. The Government of Myanmar has developed a 30-year long-term education development plan that incorporates the vision of creating "an education system that will generate a learning society capable of facing the challenges of the Knowledge Age."

ICT, through e-education, appears to be recognized under this plan. The Myanmar Education Research Bureau, the agency responsible for non-formal education, has indicated that the following elements of ICT in non-formal education objectives are included in the national plan:

- Increase education opportunities through the use of ICT in schools and community learning centers (CLCs);
- Increase the production of audiovisual and multimedia teaching materials for schools and CLCs; and
- Retrain instructors for effective use of ICT.

In addition to the Ministry of Education, which is responsible for the development and management of the education system, the government has established the Myanmar Naing-Ngan Education Committee to coordinate education activities at the national level and to serve as the highest-level decision-making body for the education sector.

Myanmar is a party to the eASEAN Framework Agreement; accordingly, the government has formed a Myanmar eNational Task Force to promote ICT. The government also established the Myanmar Information and Communication Technology Park in 2001 to promote private sector ICT development.

d. Viet Nam

Population	81,120,000	(2001)
GDP per capita ($)	410	(2001)
Main lines per 100 inhabitants	4	(2001)
Main lines per 100 households	16	(2000)
Number of mobile phones per 100 inhabitants	1.54	(2001)
Number Internet hosts per 10,000 people	0.06	(2001)
Literacy rate, Total (%)	94	(2003 estimate)
Literacy rate, Female (%)	92	(2003 estimate)
Literacy rate, Male (%)	96	(2003 est.)
Education expenditure as a percent of GNP	3	(1997)
Number of years of compulsory schooling	5	(2000)
Number of students per teacher, primary school	30	(1999—2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. There is currently no published policy. The Ministry of Posts and Telematics is both policy- maker and regulator for the sector. According to the ITU, there has been no change in legislation since 1997.

ICT in Education. The Master Plan for Information Technology in Education for the period 2001–2005 contains the following objectives:[119]

- Build IT infrastructure for education and training. This comprises computer networks (local networks, intranets, Internet), computer rooms in schools, computers in all educational institutions—schools, colleges, universities, provincial departments, and MOET (Ministry of Education

[119] Statement of the Ministry of Posts and Telematics.

and Training) departments—linked together and providing access to various databases and resources for teaching and learning activities, and for educational management.

- Develop human resources for the IT industry, to number 25,000 or 30,000 IT-trained specialists at all levels of qualification. Specialized IT training programs for other disciplines to be developed to promote IT applications in different fields. Flexible training modes are encouraged. Much attention given to the quality of training of management.
- IT use as a tool for teaching and learning for promoting innovative thinking, initiatives, communication, independent problem solving skills, information searching, and processing skills to facilitate lifelong learning for all people. Develop IT application for any subject, at any school, at any level through use of educational software (software for teaching, learning, testing, and evaluation).
- Build suitable curricula, teaching methods, and student evaluation systems for teachers' training programs. Revamp educational management through databases on students, teachers, and educational institutions as well as legal and regulation documents. This information system will make policy decision-making faster and more efficient.

More specifically, Viet Nam aims to develop a computer-based information network for education, called EduNet, and to improve computer ratios at educational institutions. The aim is that every school should have at least one classroom with five computers.

In order to reach the goal of at least 25,000 trained IT specialists by 2005, Viet Nam aims to: strengthen training quality at all IT faculties; increase technical and practical applications; regularly revise IT faculties and update their programs; set up IT faculties at other state universities; increase the intake in 2-year training programs for technicians and technologists with more emphasis on practical skills; encourage second degree training in IT for graduates holding bachelor degrees in other disciplines; create a quality accreditation committee to review programs at IT faculties and at other IT training levels; set up joint training programs with foreign universities; and, encourage students, lecturers, and researchers to study in developed countries.

As far as ICTs in schools are concerned, the major aims of the Master Plan are the provision of general knowledge about computers and IT for all schoolteachers and students, computer use for teaching and learning other subjects, and computer use for school management. Educational institutions will allocate 3% to 5% of their annual budgets to IT applications.[120]

Current Situation. According to the September 2003 Digital Review of Asia-Pacific,[121] Viet Nam had a total international Internet connection capacity of 350 Mbps (compared with 106 Mbps in June 2002), 612,000 Internet subscribers (0.77% of the population, up from 0.22% in 2002), and 2,490,000 Internet users, or 3.05% of the population.

Less Developed Countries: Pacific Region

The countries included in this category are the Cook Islands, Fiji Islands, Kiribati, Marshall Islands, Federated States of Micronesia (FSM) Nauru, Palau, Papua New Guinea (PNG), Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu. Several of the Pacific island states are currently drafting their ICT-enabling policies with support from the UNDP's e-Pacifika program[122] and the ITU Development Bureau (ITU-D). The three basic objectives of e-Pacifika are to:

- Make policy makers aware of the usefulness of ICTs in coping with domestic and emerging international issues which affect the region, such as fisheries management, natural disasters, and global warming—which threatens to raise sea levels and inundate many of the islands.
- Develop an ICT strategy for each country, prepared with support from the sponsoring organizations.
- Collaborate the e-Pacifika program with the respective countries in implementing national initiatives that will help in accomplishing their strategies. A number of pilot projects are planned.

[120] Adapted from UNESCO Bangkok, Draft document on ICT policies of Asia and the Pacific.
[121] See: http://www.digital-review.org/ahp01.htm.
[122] See: http://www.undp.org.fj/RAS-99-064.htm.

The major challenge to widespread use of ICT in the Pacific is the limited capacity of international connections through satellites, and the very high cost of access to users. Several submarine cables, including Southern Cross and PacRim, transit the region, but only the Fiji Islands and Guam are connected to a fiber cable. In July 2003, Cable & Wireless announced plans to build the Pacific Island Cable System, which would connect Australia with almost all South Pacific nations. In 2003, only three Pacific counties (Papua New Guinea, Samoa, and Tonga) offered Internet users a choice of ISPs. Users in all other countries are served by monopoly ISPs; this does not stimulate either competitive prices (dial-up rates can be as high as $10 per hour) or innovative new services, including e-commerce. Also, homes on these islands with a telephone connection are still in the minority.[123]

a. Cook Islands

Population	15,000	(2003 estimate)
GDP per capita ($)	5,000	(2001 estimate)
Literacy		Not available
ISPs	3	(2000)
Internet Users		Not available
Mobile Phones	0	(1994)
Telephone Mainline in use	5,000	(1997)

GDP = gross domestic product.
Sources: CIA World Factbook 2003.

ICT Policy. No ICT in education policy has been published. The Cook Islands ICT policy framework was to be formulated by the beginning of 2004, but no information is yet available. As understood, the framework will follow the guiding principles outlined in the Pacific Islands Information and Communication Technologies Policy and Strategic Plan (PIIPS), a regional ICT strategy agreed to and signed by the Communication Ministers of each member country of the South Pacific Forum.

[123] Adapted from 2004 South Pacific Islands Telecoms, Paul Budde Communication Pty Ltd.

An ICT Committee was established in March 2003 and chaired by the Prime Minister, who also holds the portfolio for telecommunications. The committee members are representatives of the Ministries of Finance and Education, the Office of the Prime Minister, and representatives from the tourism, telecommunication, and computer services sectors. The mandate for the committee was to advise government on ICT matters and develop a strategic plan to promote national awareness of ICT issues.[124] Government priorities in ICT were:

- Internet access for remote islands.
- Government online content required.
- Sector strategies in education, health, commerce, and governance.
- Drafting of modern ICT legislation.

Current Situation. Telecom Cook Islands (TCI) Ltd is the sole provider of local, national, and international telecommunications in the Cook Islands, with exclusive service rights to 2006. In operation since July 1991, TCI is a private company owned by Telecom New Zealand Ltd (60%) and the Cook Islands Government (40%).

Regarding policy and regulatory framework, the government believes there is no need to implement structures due to the current quality of service, the very small size of the market, customer satisfaction, and comparable pricing. For a small island state, rates are reasonable, penetration is high, and there appears to be equilibrium between the consumers' interests and return on equity for investors.

The TCI network services 6,600 customer lines from NEC and Redcom exchanges, a penetration that reaches 82% of all occupied dwellings, or 42 phones per 100 population. Customers have access to affordable and reliable Internet services. Broadband Internet is being considered. International access is through Teleglobe Canada—an arrangement negotiated through Pacific Islands Telecommunications Association (PITA) Net—a scalable service which currently provides 2 megabits down and 256 KBPS up on Intelsat satellite. The small population base requires regional collaboration for scalable services.

[124] UNESCO, Bangkok.

The major impediment to further development is the lack of economies of scale. The Cook Islands comprise 12 populated islands with a total population of approximately 15,000. Population decreased in recent years from 18,000.

TCI operates the only ISP, known as "Oyster", which has 668 dial-up Internet subscribers in Rarotonga (population 9,000) at less than $15 per month. Permanent connections, such as DSL and dedicated lines, are under consideration, and the trend is to volume billing with a lower basic monthly access fee. An Edunet program has been launched in some colleges and high schools, and some work has started on Tele-health, supported by World Health Organization and the Fiji School of Medicine. There are no secure servers yet, and the banks (ANZ and Westpac) are bringing their ATMs on line; there is no Web banking currently. Government is coming on line with an estimated 30% to 40% of the work force of 5,000 using PCs in the workplace. TCI actively supports computers in schools and supplies connectivity for education.

b. Fiji Islands

Population	822,000	(2001)
GDP per capita ($)	2,060	(2001)
Main lines per 100 inhabitants	11	(2001)
Main lines per 100 households	64	(2000)
Number of mobile phones per 100 inhabitants	9	(2001)
Number of Internet hosts per 10,000 people	8	(2001)
Literacy rate, Total		Not available
Literacy rate, Female (%)	94	(2003 estimate)
Literacy rate, Male (%)	95	(2003 estimate)
Education expenditure as a percent of GNP	5.1	(1999—2000)
Number of years of compulsory schooling	10	(2000)
Number of students per teacher, primary school	23	(1998—1999)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. There is no published policy for ICT in education. A few private schools use PCs. The Fiji National ICT Council is responsible for the formulation and execution of the National ICT Strategy Plan 2003–2005. The Plan is incorporated into the government's comprehensive Strategic Development Plan and is cognizant of Fiji Isand's Pacific island neighbor countries' national ICT strategy plans. The four Cornerstone programs include: e-Government (ITC Services),[125] e-Commerce (Ministry of Commerce), e-Personal (Ministry of Education), and ICT Industry (Fiji Trade and Investment Board).[126]

Underlying these programs is the National Information Infrastructure (NII) under the stewardship of the Ministry of Telecommunications. The government is working on a policy

[125] See www.itc.gov.fj.
[126] See www.ftib.org.fj.

document and comprehensive Strategy Plan. The first pilot e-Government project is the development of a dynamic Web site for the Immigration Department, which would allow customers to apply, pay for, and receive Immigration services online.[127]

Current Situation. Some of the major barriers restricting the expansion of affordable and widespread connectivity in the Fiji Islands are:

- The uncertain policy and regulatory environment.
- Discrepancy between government policy and action. For instance, government has licensed four new ISPs, but they are not operational because telecommunications circuit costs are prohibitive.
- Concentrated public sector investment creates conflict of interest in Telecom (the domestic carrier). Telecom is a cash cow, and thus has very different objectives than if it was considered an instrument for development.
- High cost of Internet access, limited capacity, and relatively poor performance.
- No local competition in voice and data services.
- Population in urban areas are ICT aware, but few can afford to connect.
- Telephone services are not available to more than 600 communities.
- There is yet no government strategic plan for ICT.
- A National IT Action Plan for IT-enabled Industries was agreed in principle by the Cabinet in 2002, but stakeholders are not aware of its present disposition.
- There are no secure servers in the country.
- Costs are prohibitive, e.g. a local 128 kb leased line in Suva costs equivalent to $4,000 per month.

[127] Fiji's response to Invitation to World Summit on the Information Society Prep-Com 2 and Comments on Action Plan and Declaration, 3 December 2002.

- Few sectoral ICT applications have evolved in the policy vacuum.
- Internet connectivity varies substantially as do costs: throughput on dial-up lines varies from less than 1 kb (browsers often time out) to 3.6 kb in Internet cafes, and costs from Fiji $3 up to $8 per hour.

The international carrier, FINTEL, with a tremendous international bandwidth capacity available via the Southern Cross (G2 segment)[128] submarine fiber cable, is promoting affordable high- speed Internet access and e-commerce facilities. There are significant differences between it and the domestic monopoly carrier, however, which currently will not permit consumers or businesses to connect directly to FINTEL's network.

c. Kiribati

Population	80,000	(2001)
GDP per capita ($)	430	(2001)
Main lines per 100 inhabitants	4.03	(2000)
Main lines per 100 households	26	(2000)
Number of mobile phones per 100 inhabitants	0.48	(2000)
Number of Internet hosts per 10,000 people	23	(2001)
Literacy rate, Total		Not available
Literacy rate, Female		Not available
Literacy rate, Male		Not available
Education expenditure as a share of GNP	11.4	(1996)
Number of years of compulsory schooling	10	(2000)
Number of students per teacher, primary school	24	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

[128] Segment G2: Suva, Fiji to Brookvale, North Sydney, Australia operates at 40 Gbit/s per fiber pair on 3 fiber pairs. Each fiber pair is capable of being upgraded to 160Gbit/s.

ICT Policy. Kiribati has limited policy and regulatory activity, and no Internet culture yet, due in part to very limited Internet access—only 40 dial-up ports, and about 400 Internet subscribers in South Tarawa. Christmas Island has one dial-up access modem operating through Telstra. Telekom Services Kiribati Limited (TSKL) has a monopoly and is 100% government owned. It has 2,000 main lines, operating at full switch capacity. International traffic is routed through an Intelsat B gateway at Bairiki, and TSKL allows private VSAT for education purposes. Communications to 17 outer islands are via HiFi radio grouped in 6 sub-stations with 20 to 80 mile hops.

Government's priories in ICT are: (i) outer island development, (ii) expansion of Internet access outside of South Tarawa, and (iii) outer island network infrastructure (proposal presented to ADB).

ICT in Education. The Kiribati Education Policy, with a set of National Development Strategies for 2000—2003, did not mention of ICT in either primary, secondary, or tertiary education, with the exception of adding computer studies for teachers in Junior Secondary Education.

Current Situation. The Tarawa Technical Institute offers a large number of courses in a wide range of vocational technical disciplines, including computer studies. The institute experienced a significant increase in enrollment and faculty size at the end of 1999, to 1,855 and 20, respectively. The Institute has also been very active in developing courses to meet the needs of both government and the private sector.

In a promising new initiative, the government has entered into negotiation with the University of the South Pacific (USP) to expand the USP Center program in Kiribati to encompass a substantially larger resident undergraduate program. This will enable more Kiribati students to complete their undergraduate degrees locally. The proposed program would include selected undergraduate subject disciplines and would require an expansion in both the Center faculty and classroom/lab infrastructure.

d. Marshall Islands

Population	70,000	(2001)
GDP per capita ($)	1,830	(2001)
Main lines per 100 inhabitants	6	(2001)
Number of Internet hosts per 10,000 people	0.43	(2001)
Literacy rate, Total (%)	93	(1980)
Literacy rate, Female (%)	88	(1980)
Literacy rate, Male (%)	100	(1980)
Education expenditure as a percent of GNP	15.4	(1998–1999)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	15	(1998–1999)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003

ICT Policy. There is no formal policy or regulatory structure, though the Ministry of Transport and Communications is responsible for technical regulation and some policy advice. The Ministry has no authority to insist on radio frequency licensing under current legislation, although it is responsible for both frequency management and licensing. Government priority areas in ICT are quality education and teacher support in outer islands, and training of health workers in remote areas and interconnection of dispensaries.

Current Situation. The National Telecommunications Authority (NTA), with 73% government ownership, is the monopoly telecommunications carrier. It discriminates between voice, data, and video. The NTA does not allow private networks or competing ISPs of any kind, but there is not yet any policy on VOIP. The NTA did not allow dial-in access to College of the Marshall Islands (CMI) and University of the South Pacific (USP) servers, and requires that students and teachers go through NTA's own Internet access service.

There are 28 inhabited atolls, with telephony available only on Majuro and Ebaye. There are mini-satellite telephone units in operation on some of the remote outer islands, and Kili Island has telephone service via Inmarsat. Businesses find it difficult to obtain leased lines; NTA quotes $6,000 per month for a 64 kilobit circuit between Majuro and Ebaye. Banks and retailers would like to expand to other atolls but can't communicate. NTA is currently working on developing rates for leased circuits between Majuro and the other islands that will be less expensive than international leased circuit rates.

Government is funding the Strategic Development Plan Framework (2003—2018)—Vision 2018, which includes the ICT sector. The draft provides a very objective look at telecommunications practices. An IT Master Plan is also in the process of development. The largest network is government, with about 1,000 PCs, none of which are networked. CMI has 175 PCs, and Bank of Marshall Islands has 75. CMI (with a major LAN) must buy Internet access through the NTA at a cost of $4,500 to $5,000 per month when PeaceSat[129] is not completely functional. There are about 500 mobile telephony clients. NTA has excellent infrastructure (except for analogue mobile), but expensive Internet services. It has about 600 dial-up Internet subscribers for a basic fee of $10 per month, no free hours, and bills at $0.06 for each minute of access. The school rate is $5 per month for each account.

There are no large-scale applications in health, education, governance, commerce, etc., and no published ICT education policy.

[129] The Pan-Pacific Education and Communication Experiments by Satellite. See: http://www.peacesat. hawaii.edu/01HOME/Welcome.htm.

e. Federated States of Micronesia

Population	120,000	(2001)
GDP per capita ($)	1,970	(2001)
Main lines per 100 inhabitants	8	(2001)
Main lines per 100 households	56	(2000)
Number of mobile phones per 100 inhabitants	0	(2001)
Number of Internet hosts per 10,000 people	54	(2001)
Literacy rate, Total (%)	89	(1980)
Literacy rate, Female (%)	88	(1980)
Literacy rate, Male (%)	91	(1980)
Education expenditure as a percent of GNP		Not available
Number of years of compulsory schooling	8	(2000)
Number of students per teacher, primary school		Not available

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. There is no published policy ICT. Priority areas identified by the government are:

- Capacity building in distance education.
- Link to the proposed Tycom submarine cable (Guam to Sydney) with US Department of Defence support.
- Strategic planning for ICT by the national, state, and local governments as well as town meetings for all other services, including health and education.
- Government-wide training in ICT applications.
- Extension of micro VSAT service to 22 outer islands.
- Capacity building in policy and regulation.

- Health network linking central government, states, and outer islands, and 110 dispensaries on 60 islands.
- National education network for in-service training for under-qualified teachers and to provide materials to learners.

Current Situation. The FSM Telecom Corporation is the monopoly voice, data, and ISP. It is government-owned and regulated by the Department of Transportation, Communications, and Infrastructure. All revenue is retained by the operating company for expansion of services with the objective of providing universal service. There is limited scope for policy and regulatory activity and little practical government expertise in ICT economic or technical issues. FSM Telecom does not allow resale of capacity or private VSAT systems, but does not object to VOIP. Generally, FSM enjoys an excellent telecommunications infrastructure, and a National Task Force has been created by the President to look at ICT Strategy. GSM telephone services were introduced in Yap and Ponape in July 2002.

The College of Micronesia (COM) is networked to regional campuses in each state and is in the process of introducing distance education. Teachers use their own dial-up ISP accounts to access the COM server. COM uses 64 kilobit leased lines at $200 per month per circuit. COM also connects to PeaceSat, which is frequently down due to obsolescence of equipment. Some high schools have PCs, but this varies according to the initiative of individual school principals. As yet there is no Internet culture.

There is a spread of 1,200 miles between the most distant points of the country, Yap and Kosrae. The main public access Internet Center is in Kolonia in the FSM Telecom Building. It offers two PCs, which are not heavily used, at a rate of $4 per hour. The throughput is broadband quality at about 22,000 cps. Dial-up rates for the 1,500 residential subscribers are $20 per month for the first 10 hours, then $2 per hour.

Best Practices

FSM Telecom has created a GSM test bed on Ulithi, an outer island of Yap. It is also being used to experiment with a low-cost 4.5 meter micro VSAT with 64 kilobit carrier, six voice circuits, and wireless last mile technologies for voice and Internet. Wireless systems are being installed to provide first-time service to inhabitants of the Chuuk Lagoon to remote areas in the four states, and to the maritime community.

f. Nauru

Population	12,570	(2003 estimate)
GDP per capita ($)	5,000	(2001 estimate)
ISPs	1	(2000)
Internet Users		Not available
Mobile Phones	450	(1994)
Telephone Mainline in use	2,000	(1996)

GDP = gross domestic product.
Note: There is no published policy on ICT nor ICT in education.
Source: Encarta 2003

g. Palau

Population	19,717	(2003 estimate)
GDP per capita ($)	6,280	(2001)
Number of mobile phones per 1000 inhabitants		Not available
Number Internet hosts per 10,000 people	0.53	(2000)
Literacy rate, Total (%)	92	(1980)
Literacy rate, Female (%)	90	(1980)
Literacy rate, Male (%)	93	(1980)
Education expenditure as a percent of GNP		Not available
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school 15		(1998–1999)

GDP = gross domestic product, GNP = gross national product.
Note: There is no published policy on ICT nor ICT in education.
Source: Encarta 2003

h. Papua New Guinea

Population	4,920,000	(2001)
GDP per capita ($)	560	(2001)
Main lines per 100 inhabitants	1	(2000)
Main lines per 100 households	6	(2000)
Number of mobile phones per 100 inhabitants	0.18	(2000)
Number of Internet hosts per 10,000 people	0.83	(2001)
Literacy rate, Total (%)	76	(2000)
Literacy rate, Female (%)	68	(2000)
Literacy rate, Male (%)	84	(2000)
Education expenditure as a percent of GNP	10	(1999–2000)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	36	(1998–1999)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Work is ongoing to develop a suitable policy framework through the National Information Technology Board with the support of the ITU and E-Pacifika, as part of the latter's Sector Governance Project. Key elements of the strategy are expected to be access to ICT, and contribution to poverty reduction and sustainable development through knowledge sharing.[130]

The National Information Technology Board's mandate is to:

- Manage IT in public services;
- Improve productivity and efficiency in the public service;
- Ensure IT use is appropriate to local conditions;

[130] Presentation by Kila Gulo-Vui of PNG Telecom Authority to UNDP Workshop on National IT Strategies, 9—11 April 2003, Suva, Fiji.

- Establish and maintain information systems; and
- Promote human resources and capacity building in IT with government.

ICT in Education. There is not yet a formal ICT in education policy, but many initiatives have been implemented by various donors, and other projects are being developed. The government has approved a number of initiatives:

- Education and Research Network Project to computerize data collection from the provinces for the Department of Education.
- PNG Unitech is to provide distance education opportunities for students.
- The University of PNG multimedia distance education project.
- Primary and secondary teacher education project through DL (Australian Virtual Colombo Plan). Funded by the Australian Agency for International Development (AusAid), this project will provide computer laboratories in teachers' colleges with specialized training provided by dedicated staff.

Current Situation. In 2002, PNG implemented a new telecommunications policy and regulatory framework, with the Independent Consumer Competition Commission as the single, economy-wide regulator. Policy responsibilities still reside with the Office of Communications and Information.

In education, there is a problem of overall coordination and funding, which makes it difficult to launch and sustain larger-scale projects. There is also the problem of more than 800 distinct languages used in the country, with students entering university encountering serious difficulties in adapting to the reading of materials for learning. It is believed that a multimedia learning environment would produce far better results.

The ITU is sponsoring a Telecenters Pilot Project with the objectives of:

- bridging the digital divide,
- community empowerment,
- reducing poverty and increasing household income by providing access to ICT, and

- creating learning opportunities for people in remote communities.

The World Bank is also implementing a Global Development Learning Network (GDLN) center. An interesting and innovative project was reportedly funded by the Japan International Cooperation System (JICS) in 1998, which equipped 350 schools with solar power, televisions (TVs), VCRs, and PCs as part of a structural adjustment program. It would be worthwhile to follow up on the results of this project to determine its success and whether it is possible to replicate it elsewhere.

The Community Trust Fund was also established in 2002 under the Telecommunications Industry Act. Its objective is to connect communities so that benefits flow to the community as a whole, not just to individuals. Under this program, after a clear need has been demonstrated and the community dedicates the necessary land and 20% of project cost, and the government will match funding up to 40%.

i. Samoa

Population	180,000	(2001)
GDP per capita ($)	1,470	(2001)
Main lines per 100 inhabitants	6	(2001)
Main lines per 100 households	24	(2000)
Number of mobile phones per 100 inhabitants	2	(2001)
Number of Internet hosts per 10,000 people	300	(2001)
Literacy rate, Total (%)	100	(2003 estimate)
Literacy rate, Female (%)	100	(2003 estimate)
Literacy rate, Male (%)	100	(2003 estimate)
Education expenditure as a percent of GNP	3.9	(1999–2000)
Number of years of compulsory schooling	10	(2000)
Number of students per teacher, primary school	24	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. An ICT Master Plan calls for specific activities,many of which are well under way with support of the World Bank, such as:

- Establishing a Telecommunication Regulatory Framework.
- Setting up an ICT Council to formulate national ICT Policy as well as to guide planning of all ICT matters.
- Establishing a Regulatory Commission to ensure that all service providers adhere to required ICT standards.
- Setting up a Spectrum Management Agency to administer frequency allocations.
- Improving infrastructure through installation of fiber-optic technology, introduction of competition in the cellular market, and increased bandwidth for internet services.
- Standardizing ICT development in both hardware and software.
- Analyzing the impact of ICT on employment.
- Establishing a separate ICT Ministry with strong policy and regulatory capacities. Currently, the Ministry of Posts and Telecommunications is responsible for policy making as well as regulating the telecommunications and postal sector.
- Ensuring scope to cover such areas as education, health, rural access to ICTs (e.g. Internet cafes and telecenters), private sector development, and public sector reform.

ICT in Education. The ICT Master Plan of Samoa directly supports the Department of Education's 2000—2003 Corporate Plans. However, it does not address the utilization of ICTs in schools, curriculum development, and materials production processes. It focuses on IT applications to improve the efficiency and effectiveness of administrative and planning functions within the departmental headquarters. The following needs are outlined in the Master Plan:

- Preparing and maintaining a data model, such as an EMIS.
- Identifying systems for re-engineering and application of standards to the re- engineering process.
- Adopting and enforcing software standards.
- Implementing an ongoing system for virus protection.

- Implementing standards for database development.
- Adopting a standard PC platform.
- Preparing and implementing standards for purchasing PCs.
- Implementing a network by phases.
- Providing Internet access.
- Establishing an ICT steering committee.
- Providing staff training.
- Outsourcing hardware maintenance.

The plan can be considered a preparatory step toward interconnecting the Ministry's infrastructure and, eventually, connectivity in schools. The Department acknowledges that computer skills have a strong impact on employment opportunities of school and university graduates. It is also aware that, before students have the opportunity to learn computer knowledge, teachers first need to use ICT tools and be competent and confident in their use.

In 2003, the Department of Education conducted a study entitled, Information Technology in the Classrooms, indicating recognition of the importance of ICTs in education. The objective of the study was to determine the areas where teachers need training before computers are put into their classrooms as tools for learning and teaching. It was found that the majority of teachers had either very limited knowledge or no knowledge of computer usage. However, most teachers indicated that they would very much like to learn more. Excel was the computer program that surveyed teachers knew most about; knowledge of Word was far behind.

In December 2003, the World Bank concluded arrangements for a $6.33 million loan for the Samoa Telecommunications and Postal Sector Reform Project, to cover postal and telecommunications policy and regulatory reform, assess privatization options for the domestic telephone carrier, introduce competition in digital cellular telephony, and pilot a number of Telecenters across the country.

j. Solomon Islands

Population	463,000	(2001)
GDP per capita ($)	610	(2001)
Main lines per 100 inhabitants	2	(2001)
Main lines per 100 households	11	(2000)
Number of mobile phones per 100 inhabitants	0.21	(2001)
Number of Internet hosts per 10,000 people	9	(2001)
Literacy rate		Not available
Education expenditure as a percent of GNP	3.6	(1999–2000)
Number of years of compulsory schooling		Not available
Number of students per teacher, primary school	23	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

Current Situation. There is no published policy on ICT nor ICT in education. The People First Network, or PFnet, is a UNDP/United Nations Office for Project Services-established ICT project comprising a rural email network. It is aimed at promoting and facilitating equitable and sustainable rural development and peace by improving information sharing and knowledge building among and across communities of the Solomon Islands. This project is very successful and is being supported by a partnership comprising the Rural Development Volunteers Association (RDVA), an NGO in the Solomons, the Japanese Grassroots Assistance Program, the University of the South Pacific, the Embassy of Japan in the Solomons, the British High Commission in the Solomons, the Australian High Commission in the Solomons, and the Asia-Pacific Development Information Programme (APDIP).[131]

[131] See http://www.undp.org.fj/PFnet.htm; or http://www.peoplefirst.net.sb/.

k. Timor-Leste

Population	997,853	(2003 estimate)
GDP per capita ($)	520	(2001)
Number of telephones per 1000 people	15	(2000 estimate)
Number of Internet hosts per 10,000 people		Not available
Literacy rate, Total (%)	43	(2001 estimate)
Literacy rate, Female (%)	43	(2001 estimate)
Literacy rate, Male (%)	43	(2001 estimate)
Education expenditure as a percent of GNP		Not available
Number of years of compulsory schooling		Not available
Number of students per teacher, primary school	50	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. No policy has been published for ICT in education. Several groups are involved in developing ICT policy in Timor-Leste. One is the National Youth Forum, which was held in October 2003 in Dili with the objective of formulating a national action plan and identifying youth and ICT projects for Timor-Leste. It was apparently organized with support from some government departments and UNDP. One outcome of this event was the following Strategic Intent:

- Increase the knowledge of Timorese society of the potential of ICT for workforce development and employment creation.
- Develop effective ICT capacity-building projects and programs for youth during the period 2004—2006.
- Develop a strategic plan and timetable to enable multi-track knowledge sharing of ICT programs, funding, and TA that can be used to develop youth and ICT projects and program.

- Promote the creation of national and external partnership building between youth and youth service organizations, government, inter-governmental organizations, and NGOs to develop effective ICT-youth capacity-building programs and initiatives.

There are indications that the UNDP ICT for Development in Asia-Pacific is drafting a project to support the preparation of a national ICT policy.

Current Situation. The telecommunications infrastructure was heavily damaged during the burning and looting that occurred in 1999. The country started the long process of rebuilding its infrastructure with considerable support from the United Nations. With formal independence in May 2002, the rebuilding process is continuing with ongoing assistance from the international donor community. Telstra started operating the existing infrastructure under interim arrangements with the United Nations. A new operator, Timor Telecom, was selected by the government in July 2002 and it took over from Telstra in March 2003.[132] The major technical constraints include:

- Power limitations, as Timor Telecom must provide a generator at each site.
- All telecommunication equipment had to be installed in containers because all buildings were destroyed.
- There are no transmission trunk lines in place.
- There is no local ICT manufacturer.
- Human resources are a big challenge for the government and Timor Telecom. At present, there are minimal human resources with the capabilities to deal with ICT issues.

The government is seeking to develop the capacity to regulate the operators, such as Timor Telecom and ISPs, to ensure they provide adequate quality of service and the best price for their customers. At the moment, there is no specific framework for the regulation of internet-based services. This issue will be addressed through the

[132] 2003 *Telecommunications and Information Highways in Asia*, Volume 9.

definition of a regulatory framework to be set up during 2004. The government has issued recommendations to some ISPs, such as Timor Telecom, East Timor Communication, and I-NET, in order to start providing basic services to Internet users.[133] Another challenge is to educate people in the use of ICT facilities. A first priority will be to provide e-government services, taking advantage of reconstruction activities.

l. Tonga

Population	98,500	(2001)
GDP per capita ($)	1,410	(2001)
Main lines per 100 inhabitants	10	(2000)
Main lines per 100 households	60	(2000)
Number of mobile phones per 100 inhabitants	0.14	(1999)
Number of Internet hosts per 10,000 people	2	(2001)
Literacy rate, Total (%)	100	(1995)
Literacy rate, Female (%)	100	(1995)
Literacy rate, Male (%)	100	(1995)
Education expenditure as a percent of GNP	4.7	(1992)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	21	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. No recent policy has been published on ICT in education. The government's policy framework is driven by an understanding that expanded connectivity will stimulate domestic growth and provide scope for greater Tongan participation in the

[133] Adapted from Statement by the Minister for Transports, Public Works and Communications, República Democrática de Timor-Leste at the World Summit on the Information Society, 10—12 December 2003.

global information economy. Its statement of objectives is designed to not only capture the imperatives necessary to deliver gains in the provision of communications services, but to guide the overall development of the communications sector*:* "To improve sector performance to ensure domestic and global connectivity throughout the Kingdom of Tonga. This includes improving quality of service, geographic coverage. "

m. Tuvalu

Population	11,305	(2003 estimate)
GDP per capita		Not available
Number of mobile phones per 1000 people		Not available
Number of Internet hosts per 10,000 people		Not available

Source: Encarta 2003

ICT Policy. The Tuvalu National ICT policy, Information and Communication Technologies for every Tuvaluan Citizen was in draft form pending negotiations with stakeholders. Implementation was expected by 2004. The Tuvalu Policy Vision follows the guiding principles outlined in the Pacific Islands Information and Communication Technologies Policy and Strategic Plan—the regional ICT strategy agreed to and signed by Communication Ministers from each member country of the South Pacific Forum. For Tuvalu, these principles are:

- ICT will be used to inform and connect Tuvalu citizens, and ensure that they benefit from flexible and appropriate education and training.
- Appropriate ICT infrastructure will support development for Tuvalu Islands.
- Easy access to information through ICT will strengthen cooperation between stakeholders to ensure good governance, development of the private sector, and improvement in service delivery.

- ICT policies and regulations will be appropriate to the people and culture of Tuvalu.

Strategies to implement the aspects of the ICT policy that are relevant to education include:

- Promoting greater awareness of ICT,
- Developing and retaining a workforce knowledgeable in ICT,
- Developing and maintaining training policies and programs to ensure ICT resources are properly managed,
- Providing equal access to ICT,
- Developing ICT infrastructure to promote universal access,
- Addressing affordability of ICT technology, and
- Continually evaluating ICT plans and its impacts.

Other planned strategies include consultation with a wide range of stakeholders, developing exchange and vocational programs by the education sector, incorporating gender issues, and developing community awareness programs to maximize benefits and minimize adverse social impacts. There are also plans to review communication tariff regulations to maximize benefits to communities.[134]

[134] UNESCO Bangkok. ICT policies of Asia and the Pacific (Draft).

n. Vanuatu

Population	201,000	(2001)
GDP per capita ($)	1,060	(2001)
Main lines per 100 inhabitants	3	(2001)
Main lines per 100 households	17	(2000)
Number of mobile phones per 100 inhabitants	0.17	(2001)
Number of Internet hosts per 10,000 people	18	(2001)
Literacy rate, Total (%)	53	(1995)
Literacy rate, Female (%)	48	(1995)
Literacy rate, Male (%)	57	(1995)
Education expenditure as a percent of GNP	7.2	(1999–2000)
Number of years of compulsory schooling	7	(2000)
Number of students per teacher, primary school	23	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

Current Situation. There is no published policy on ICT nor ICT in education. Approximately 35,000 students attend elementary school in the country. However, only 7,000, or approximately 20%, move on to secondary schools. This unfortunate dropout rate is due in part to the lack of secondary facilities, or slots for students wishing to continue their education. Of the 7,000 students who enroll in secondary schools, only 100 students—or 1.4%—advance to tertiary level. Additional concerns have been expressed by the Minister of Education: the curriculum is weak at every level of the system; teachers are in short supply and difficult to recruit, especially outside of Port Vila; and teachers are inadequately trained. A social crisis is in the making, as close to 50% of the population is under the age of 15, mostly with little practical education or skills, and few prospects for a meaningful future.

Less-Developed Countries: South Asia Region

The countries in this category include Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, and Pakistan.

a. Afghanistan

Population	22,474,000	(2001)
GDP per capita ($)	523	(1998)
Main lines per 100 inhabitants	0.13	(2001)
Main lines per 100 households	0.86	(2000)
Number of mobile phones per 100 inhabitants	0	(2001)
Literacy rate, Total (%)	36	(2000)
Literacy rate, Female (%)	21	(2000)
Literacy rate, Male (%)	51	(2000)
Education expenditure as a percent of GNP	2	(1980)
Number of years of compulsory schooling	6	(2000)
Number of students per teacher, primary school	58	(1997)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Afghanistan already has in place two key building blocks for a national ICT policy: the National Telecommunications Policy, issued in July 2002, and the Telecommunications Development Strategy, issued in October 2002. These documents tackle critical aspects of building communications infrastructure, yet issues of content and capacity building must be addressed before further progress can be made toward the development of a national ICT policy. The government has adopted a set of principles to guide the development and implementation of policy:

- An interconnected and interoperable network of networks. Existing and planned public and private networks must be

linked together to create a seamless information and communications infrastructure.

- Collaborative public and private sector development. For the foreseeable future, the government will play a leading role in ICT sector development. A sustainable financing strategy for both the immediate and long-term is needed. In the near term, it is imperative that donor funds are allocated to assist with urgent development priorities.
- Competition in facilities, products, and services. A fair and competitive environment is the cornerstone of the National Telecommunications Policy. Pro-competitive policies will be applied to the greatest extent possible in all aspects of ICT development.
- Privacy protection and network security. ICT networks will multiply the flow of information and the related privacy and security challenges must be addressed.
- Lifelong learning as a key element in ICT policy. Efforts should include the development of distance and e-learning programs for women and school children and for upgrading work-related skills. Emphasis will be on the stimulation of free and open source software development.[135]

Current Situation. According to the World Bank Press in September 2003, international donors had provided $3 million in grant funds to Afghanistan to rebuild the country's destroyed telecommunications system through the World Bank's Afghanistan Reconstruction Trust Fund. The grant will also encourage investment in Afghan Telecom and help in the transition from its current status as a government department to a corporation, and eventually to a privately-owned business. Currently, only one in 625 Afghans has a telephone.

The Ministry for Telecommunications will also implement a government project aimed at improving communications between Afghanistan's provincial governments and the central authority in Kabul through a fiber-optic distribution network. It is estimated that Afghanistan needs $300 million in private investment over 3 years to

[135] Compiled from UNESCO unpublished document on ICT policies of selected countries in Asia-Pacific.

transform its fledgling telecom sector into a countrywide network, which was virtually pulverized into non-existence during decades of conflict. Kabul has also just concluded negotiations with the World Bank on a 3-year project that would include a government satellite Internet network to cover the whole country and provide the potential of connectivity and access to information to all Afghans.[136]

b. Bangladesh

Population	131,269,860	(2001)
GDP per capita ($)	350	(2001)
Main lines per 100 inhabitants	0.39	(2001)
Main lines per 100 households	2	(2000)
Number of mobile phones per 100 inhabitants	0.40	(2001)
Number of Internet hosts per 10,000 people	0	(2001)
Literacy rate, Total (%)	43	(2003 estimate)
Literacy rate, Female (%)	32	(2003 estimate)
Literacy rate, Male (%)	54	(2003 estimate)
Education expenditure as a percent of GNP	2.3	(1999–2000)
Number of years of compulsory schooling	5	(2000)
Number of students per teacher, primary school	59	(1998–1999)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Government policy aims at building an ICT-driven nation and a knowledge-based society by the year 2006. To accomplish this goal, a countrywide ICT-infrastructure will be developed to ensure access to information by every citizen. The aim is to empower people and enhance democratic values and norms for sustainable economic

[136] World Bank.

development by using the infrastructure for human resources development, governance, e-commerce, banking, public utility services, and all sorts of online, ICT-enabled services.

ICT in Education. The government says that Bangladesh must prepare itself to compete effectively in the global ICT market. As the demand for skilled manpower in ICT is growing worldwide, the country needs to produce a large number of ICT professionals. Government's major policy statements on ICTs in the learning environment include the following:

- Widespread introduction of ICT education in public and private educational institutions is a prerequisite for producing skilled ICT manpower. Facilities shall be built to promote ICT education and computer-aided education at all levels of education, including Primary Schools and Madrasahs. Donor agencies, NGOs, and other development partners shall be encouraged to help build the necessary capacity in this area.
- Universities, institutes of technology, and colleges—in both the public and private sectors—shall be strengthened to produce ICT graduates in 4-year computer science and/or engineering courses. Necessary resources will be allocated to these institutions.
- Out of the three Science and Technology universities proposed in the Fifth Five-Year Plan, one will be earmarked as center of excellence in ICT by provision of a higher allocation of resources.
- Multimedia institutes will be established up to the district level to start producing skilled human resources to exploit the opportunity offered by the growing multimedia market.
- Diploma and Trade courses in ICT will be offered in both public and private institutes, including polytechnics. Continual skill upgrading of existing professionals working in the public and private sectors shall be ensured by in-service training programs.
- The shortage of trained and qualified teachers and trainers for ICT education and training is a bottleneck in the human resource development (HRD) plan. To address the issue, IT capacity-building in the Teachers Training Institutes (TTI) and

other appropriate institutions will be taken up. To teach the teachers and trainers, intensive post-graduate diploma courses will be introduced in TTIs. Training programs to train and retrain them periodically to keep them current with progress in ICT will be introduced. ICT literacy will be a desirable requirement in the recruitment and selection of teachers. Divisional training centers will provide training of trainers to build up sufficient numbers of skilled trainers.

- As it would be difficult to train teachers in ICT in large numbers using the present infrastructure, virtual ICT teachers will be deployed wherever possible. CD and Web-based courseware development and use shall be encouraged to promote computer-aided education at all levels of education.
- To address teacher deficiencies in English and mathematics, a crash program shall be established to train them. To ensure appropriate standards and quality of ICT education, a national certification and accreditation system shall be developed and implemented.
- Programs will be established to develop quality ICT professionals and skilled personnel to ensure success in the global software and ICT-enabled services market. The formal and informal sectors will be encouraged and supported to adopt internationally-accepted standards in training programs and to introduce globally acceptable standards.
- The potential of ICT will be utilized to deliver distance education to help stretch the country's limited teaching resources and ensure quality education to all.
- Academics will be brought in from abroad in the fields where local teachers are not available.
- Syllabi and course curricula for all levels of computer science education will be updated continuously

Current Situation. Telecom and ICT sectors have been partially liberalized. Private operators are providing all types of telecommunication and ICT services in urban and rural areas. Private operators offer mobile, paging, radio trunking, and Internet services. Private operators have also been awarded licenses to operate digital exchanges at rural Thana headquarters.

Four private companies are operating cellular mobile telephone services. Together, they cover almost all the country (60 districts out of 64) with more than 1.5 million subscribers. Bangladesh Telegraph and Telephone Board (BTTB) is entering the market as a cellular mobile telephone operator in 2004 to help ensure competition.

ISP services are open to private operators, and BTTB is also an ISP. BTTB still has the urban monopoly in fixed telephone service (landline) with over 600,000 connections. As of September 2002, two other companies are offering fixed telephone service in 399 rural Thana headquarters to facilitate rural telephony; they have some 24000 connections to date.

Basic phone rates ($ 0.025) are reasonable, but domestic trunk calls range from $0.1 to $0.2 per minute and are deemed very expensive in local terms. International calls range from $0.33 to $0.66 per minute, which is also expensive by local standards, with the average monthly salary of a government primary schoolteacher at $36. VOIP is not yet legal in Bangladesh. Illegal call cards are widely available with call rates of only $0.10 to $0.50 per minute to the US. BTTB is planning to reduce international call charges to thwart the "illegal" calling card business. DSL, ISDN, and Cable TV Broadband connectivity are available. The cost of installation depends on the speed and type of connection, and ranges from $50 to $1,800. The cost for installation of 64 kbps duplex (throughput both up and down) is $1,800. Broadband connections are only available in Dhaka, Chittagong, and Sylhet, and connections are reliable.

With eight million students in more than 27,000 schools in Bangladesh, needs ranging from access, to professional development, to infrastructure are critical. Within this context, the government realizes that the best leverage to help solve these problems is the use of information technology within a sound policy framework. Bangladesh plans to use ICT as the main engine for socioeconomic development. Although the government has declared ICT as a priority sector, implementation of ICT policy is quite slow due to the lack of expertise and shortage of funds.[137]

[137] Information contributed by ITU, UNESCO Bangkok, and local experts.

c. Bhutan

Population	690,000	(2001)
GDP per capita ($)	640	(2001)
Main lines per 100 inhabitants	2	(2001)
Main lines per 100 households	2	(2000)
Number of mobile phones per 100 inhabitants	0	(2001)
Number of Internet hosts per 10,000 people	16	(2001)
Literacy rate, Total (%)	47	(2000)
Literacy rate, Female (%)	34	(2000)
Literacy rate, Male (%)	61	(2000)
Education expenditure as a percent of GNP	4.1	(2000)
Number of years of compulsory schooling	11	
Number of students per teacher, primary school	42	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. In June 2001, with support from UNDP, the government adopted an ICT Development Master Plan for 2002–2007. The cost of its implementation was estimated at the equivalent of slightly more that $21 million. The Plan is one of the most realistic and detailed of all the countries included in this review. Development and application of IT in Bhutan will be guided by three broad IT policy objectives:

- IT will be used as an integral tool to enhance good governance.
- IT and IT-enabled industries will be developed to generate employment and income.
- IT will be applied to improve the livelihood of all Bhutanese citizens.

The policy and regulatory framework is entrusted to several government agencies that are to oversee IT-related activities, each agency having a defined mandate. The Department of Information Technology (DIT) is responsible for coordination and promotion of IT in Bhutan; the Central Statistics Office (CSO) is mandated to coordinate data gathering and analysis; the National Agency for Geographic Information Systems Coordination promotes the use of Geographic Information Systems under the CSO to coordinate the collection and dissemination of geographic information; the Bhutan Telecom Authority regulates telecommunications; and the Bhutan Network Information Center is the authority regulating Internet names for Bhutan.

DIT, established within the Ministry of Information and Communications, will play a catalytic role in ensuring the rapid and effective application of IT. Its plan is to involve the private sector at every step. DIT will seek to play the role of enabler and pathfinder, primarily providing technological guidance and IT training opportunities, and creating a competitive but remunerative environment conducive to the achievement of the highest standards. The Department comprises three Sections: Research and Development; HRD; and Legislative and Regulatory.

ICT in Education. The HRD Section in DIT is to play a lead role—-in cooperation with the Department of Education—in mobilizing resources for the procurement and distribution of computers and software to schools, colleges, and other educational institutions. While this will be constrained by the availability of resources, the objective will be to create as much direct access and exposure to computers as possible. Also in cooperation with the Department of Education, the Section will play an important part in the formulation and improvement of IT-related curriculum. The Section will implement programs to create interest in IT, including encouraging the formation of computer hobby societies and the organization of programming competitions with the award of prizes and official recognition. The Section, in cooperation with other organizations currently handling training opportunities for government and the private sector, will play a role in the identification of courses and selection of trainees receiving scholarships in the IT sector. The Section will address training needs in the private sector, in government, and in the education sector. It will also arrange training opportunities for private sector professionals,

both in country and externally, and provide guidance and access to training materials to encourage self-learning.

The Section has specific objectives in key sectors. In government, its objectives are to:

- Revise and periodically update requirements of, and career paths available to, IT professionals in the civil service.
- Establish a system of certification for IT professionals in government, with the periodic need to obtain re-certification in order to maintain IT professional status. Third party certification will be prepared from the likes of Microsoft, Oracle, and Cisco, among others.

In the private sector, Section objectives are to:

- Establish and periodically update standards for private IT training institutes in the country.
- Establish a system for the professional certification of successful trainees of such private institutions.
- Establish a system of certification for IT professionals in the private sector, requiring such qualification as a prerequisite for undertaking development contracts, ideally using certification courses offered by companies such as Microsoft, Oracle, and Cisco, among others.

Human resource development in ICT in Bhutan is critical with an acute shortage of IT personnel, and a low computer literacy rate. As IT develops, the need for well-trained IT personnel will continue to grow. The only viable long-term solution to the shortage of IT staff and lack of computer literacy is to train Bhutanese citizens in IT. To provide for Bhutan's immediate needs, employees, high school dropouts, and unemployed youth will be given IT training. In order to ensure sufficient IT personnel for the future, however, Bhutan's schools will be given the responsibility to train IT personnel and provide computer literacy training to all students. A number of policies and programs with dedicated budgets have been identified in this regard:

- Certifying private IT institutes.
- Conducting all IT training in the country.
- Subsidizing IT training courses for the unemployed and for high school dropouts.
- Optimizing placement of IT professionals in government.
- Creating comprehensive IT HRD Master Plan.
- Creating a Bhutan IT forum.
- Providing IT training in all schools.
- Pursuing information management and content development.
- Computerizing vital government processes.

Current Situation. Bhutan, until relatively recently, was isolated from the world in terms of its telecommunications capability. The country's mountainous landscape has been a barrier to the development of any sort of infrastructure. Connectivity in Bhutan began with the introduction of trunk calls between Bhutan and India. It was not until 1999, however, that television, satellite dishes, and Internet services started to appear in Bhutan. Between 1996 and 2002, this small country of less than a million people had invested around $27 million in telecommunications infrastructure to provide the country with a modern fixed network.[138]

Bhutan now has a good digital telecommunications network covering all 20 districts. The national network uses a 34Mbps digital microwave backbone with a few 8 Mbps links to the minor switching centers. The government has recently completed a Rural Telecommunications Master Plan, which outlines its plans to provide at least one telephone to every *Geog* (block) in the country.

Bhutan has one ISP, DrukNet. Dial-up Internet connectivity at a maximum speed of 33.6 Kbps is available throughout Bhutan for the price of a local call, and 64KB or 128KB leased lines are available for larger organizations. Presently, there is no cable modem or ISDN services in Bhutan. International connectivity to the Internet is provided through only one 1 Mb international satellite link via British

[138] Paul Budde Communication Pty. 2003. *Information Highways and Telecommunications in Asia*. Volume 8. Global Information Inc.

Telecom. The cost of the link is high, but it is not yet reliable, resulting in frequent interruptions of Internet service. DrukNet maintains approximately 800 accounts and there may be as many as 2,500 Internet users in Bhutan.

Computers were first introduced in Bhutan in 1984. Although a recent survey revealed a total of 2,550 computers in the country, government sources believe there could be as many as 4,000. Fifty-two of the 103 agencies recently surveyed have LANs, 20 more than 5 years ago. Of the organizations that do not have a network, 70% felt they required one but have neither money or qualified technical personnel, or both. Only 16% of organizations responded that they do not need a network. The number of computers in district administrations has also grown rapidly over the past few years. On average, there are more than 10 computers in each district administration. However, none of the districts have a network. Ninety percent of surveyed organizations have an Internet connection, but it reaches only 47% of all computers in those organizations. Among the district administrations, 80% of the administrations have Internet access, but it reaches only 27% of their computers. Over 90% of the Internet links are through dial-up connections, although 10 government agencies access the Internet through leased lines.

Bhutan has six Internet cafés—four in Thimphu and two in Phuentsholing—providing public access to online information. Most individuals cannot afford to use the cafés on a regular basis. Elsewhere in Bhutan, public access to the Internet is not yet available.

Currently, there are two government institutes that provide computer courses: RIM and Sherubtse College. The National Technical Training Authority also provides IT training through the Royal Bhutan Polytechnic and the Kharbandi Technical Institute. The intake capacity in these institutes is limited, however, so the number of IT personnel graduating each year is small. There are six private IT training Institutes, but they are capable of providing only basic courses.

d. Maldives

Population	270,000	(2001)
GDP per capita ($)	2,080	(2001)
Main lines per 100 inhabitants	10	(2001)
Main lines per 100 households	61	(2000)
Number of mobile phones per 100 inhabitants	7	(2001)
Number of Internet hosts per 10,000 people	10	(2000)
Literacy rate, Total (%)	97	(2003 estimate)
Literacy rate, Female (%)	97	(2003 estimate)
Literacy rate, Male (%)	97	(2003 estimate)
Education expenditure as a percent of GNP	6.5	(1998–1999)
Number of years of compulsory schooling	7	(2000)
Number of students per teacher, primary school	24	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The Maldives' ICT policy is currently included in the 1 August 2001 Maldives Telecommunication Policy 2001—2005, as published by the Ministry of Communication, Science, and Technology.[139] Its major policy objectives are to:

- Reduce charges for all telecommunication services.
- Expand telecommunication services and reduce the disparity in service provision between Male' and the other islands.
- Open the telecommunication sector and encourage competition.
- Make government revenue from the telecommunication sector less dependent on the profit of the sector.

[139] See http://www.mcst.gov.mv/Downloads/Documents/Telecom%20Policy-Public.pdf.

- Facilitate the use of ICT in all areas of development by: (i) conducting ICT awareness and training programs to promote usage of ICTs; (ii) establishing community telecenters throughout the country to provide affordable and easy Internet access; (iii) formulating plans to establish a wideband data network connecting the entire country using the most appropriate technology; and (iv) developing human resources required for the information-communication needs of the country, and retain them within the country.

ICT in Education. An ICT in education policy will be developed within National ICT Policy. The analysis of the education sector in the Science and Technology Master Plan focuses on three major aspects of ICT seen to be closely interrelated:

- the use of ICTs in the management and administration of the education sector and educational institutions,
- the use of ICTs in the instruction and delivery of educational services, and
- ICTs as the subject of study and research.[140]

Current Situation. The Maldives can justifiably claim an efficient, up-to-date telecommunications system. Through the recent efforts of its monopoly telephone company, Dhivehi Raajjeyge Gulhun Pvt Ltd (Dhiraagu), there is now full telephone service coverage of the archipelago. As well as operating the fixed-line network, the company also operates a GSM cellular mobile service and is an ISP. Its monopoly runs out in 2008, but there are moves afoot to open parts of the market earlier. The licensing of a second ISP in the Maldives signaled the government's interest in opening up the market before 2008 (footnote 153).

Substantial improvements have been made by the Ministry of Education in the use of technology in its management and administration of the education system over the last decade. The Ministry has developed its own intranet with information such as a school directory (name of the school, island, and phone number), an

[140] See http://www.mcst.gov.mv/Downloads/Documents/S&T/Part2-06Education.pdf.

activities calendar, and directives from the Minister. Few persons, however, actually seem to use this intranet, mainly because they may not be aware of the information available and its relevance and usefulness in their work. As of August 2000 there were only two computers connected to the Internet in the entire Ministry. Development of an EMIS for the Ministry of Education and its affiliated agencies and schools has been recommended, but not implemented. The use of technology in instruction still remains minimal in Maldives. Most schools in Male', and Atoll Education Centers and Atoll Schools, have radios, tape players, and VCRs. However, availability of audio-visual equipment is limited in many community and private schools on the atolls. The actual use of these facilities is even more limited. Most teachers, especially in the atolls, depend almost solely on lecturing and the blackboard.[141]

e. Nepal

Population	23,594,000	(2001)
GDP per capita ($)	240	(2001)
Main lines per 100 inhabitants	1	(2001)
Main lines per 100 households	6	(2000)
Number of mobile phones per 100 inhabitants	0.07	(2001)
Number of Internet hosts per 10,000 people	0.67	(2001)
Literacy rate, Total (%)	45	(2003 estimate)
Literacy rate, Female (%)	28	(2003 estimate)
Literacy rate, Male (%)	63	(2003 estimate)
Education expenditure as a percent of GNP	2.9	(1999–2000)
Number of years of compulsory schooling	5	(1998)
Number of students per teacher, primary school	38	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

[141] Background documents for Science and Technology Master Plan.

ICT Policy. The Information Technology Policy, 2057 (2000) seeks to achieve the following objectives:

- Make information technology accessible to the general public and increase employment through this means.
- Build a knowledge-based society.
- Establish knowledge-based industries.

The following ICT strategies are to be adopted to accomplish the above-mentioned objectives through rapid development and extension of information technology in a fair and competitive manner.[142]

- The government shall act as a promoter, facilitator, and regulator.
- High priority shall be accorded to research, development, and extension of information technology with the participation of the private sector.
- Competent manpower shall be developed with the participation of both the public and the private sectors for the sustainable development and extension of information technology.
- Information technology shall be applied for rural development.
- Speedy and quality service shall be made available at a reasonable cost by creating a healthy and competitive atmosphere among information technology service providers.
- Computer education shall be incorporated in academic curriculum starting from the school level.
- Professional efficiency shall be enhanced through the use of information technology.
- The information technology network shall be extended to rural areas.

[142] Selected topics are listed for the sake of brevity.

The IT Policy includes a detailed Action Plan[143] to implement the national information technology policy and fulfill its objectives on (i) participation of private sector in infrastructure development, (ii) infrastructure development, and (iii) dissemination of information technology. For infrastructure development, the following arrangements shall be made for development of infrastructure related to information technology:

- An info-super highway and north-south info-highway shall be built taking into account the rapidity of information flow, changes introduced through information flow, and the gradual development of multimedia service. Nepal shall be linked with other parts of the world through a broadband information network.
- An IT park shall be established at Banepa in Kabhrepalanchok District. Such IT parks shall be established elsewhere as required with private sector participation.
- Internet nodes shall be established in all development regions by fiscal year 2058/059 (2001/2002) and in District headquarters by fiscal year 2060/61 (2003/2004) with participation of the private sector in order to make Internet facilities available throughout the Kingdom. The use of the Internet shall be gradually extended to rural areas as well. Charges for telephone calls for Internet use shall be gradually reduced.
- Telecommunications and electricity services shall be provided to entrepreneurs involved in the information technology sector as per their need.

For dissemination of information technology:

- Educational institutions and hospitals in areas where telecommunication and electricity services are already available shall be encouraged to use IT-enabled services. In places where electricity is not available, the development of IT with solar power systems shall be encouraged.

[143] We quote only selected items relevant to education and development.

- DL systems shall be introduced through the Internet and intranet, apart from radio and television. Networking systems like Schoolnet, research-net, commerce-net and multilingual computing shall be developed.
- A 3-year program shall be formulated and launched to extend the use of computers in government offices. Ministries, departments, and offices shall be linked to the Internet; other agencies shall be encouraged to be so linked.
- Web sites for all ministries, departments, and district offices shall be created within one year. Necessary legal provisions shall be made to reduce the use of paper by using information technology in all kinds of government activities in a phased manner.
- An action plan shall be devised and introduced to include computer education as a subject for the examination of a specified rank and make it obligatory for the applicants taking a written examination during recruitment. Provisions shall also be made for prescribing basic computer training as a requirement for the promotion of employees.
- Content shall be prepared to enhance Nepali materials on the Internet to preserve Nepali arts and culture as well as to develop rural areas.
- A public awareness campaign on the utility of information technology shall be launched extensively through the electronic media.
- Provision shall be made for an information officer in each ministry in a phased manner.
- In view of the present development of information technology, provisions shall be made to open voice mail to talk point-to-point for business purposes without a link to the public telephone network.

ICT in Education. Government plans in this area are provided in the National IT Policy as follows:

- Necessary facilities shall be provided to universities in the country, and graduate and post-graduate-level classes of

international standard shall be offered in computer science and computer engineering subjects.

- A long-term program with a slogan "Computer education to all by 2010 AD" shall be formulated, and computer education shall be offered as an optional subject in some public secondary schools from the coming academic year; it shall be made a compulsory subject in phases.
- IT shall be used to improve the quality of education.
- The private sector shall be encouraged to prepare the middle-level manpower required for the information technology sector. Assistance shall be provided to the private sector to set up institutions for education, research, and development in the field of information technology in each development region.
- Computer knowledge shall gradually be made compulsory to all newly-recruited teachers so as to introduce computer education in schools. Computer education shall also be provided to all in-service teachers in phases using various means, including distant education.
- Emphasis shall be given to provide computer education from the school level. Internet facilities shall be made available free of cost to universities and public schools for four hours a day within the next 5 years to provide computer education in a systematic way.
- Government shall provide scholarships to public and private sector technologists for higher study in information technology.
- Necessary scholarships shall be provided to poor and meritorious students from remote areas to pursue higher studies in information technology.

Current Situation. Telecommunication services have been growing strongly in Nepal over the last decade. However, more than 50% of demand remains unsatisfied. Rural areas in particular are underserved and require higher investment. More than 60% of the telephones remain concentrated in the capital, Kathmandu, while 55% of villages still have no telephone access at all. Even in the capital region, lines often are disconnected and calls often are not properly

terminated. At the same time, a further complication in the development of the sector has been the widespread insurgency by Maoists rebels, which has taken a serious toll on telecommunications infrastructure throughout the country.[144]

f. Pakistan

Population	144,971,000	(2001)
GDP per capita ($)	410	(2001)
Main lines per 100 inhabitants	2	(2001)
Main lines per 100 households	13	(2000)
Number of mobile phones per 100 inhabitants	0.55	(2001)
Number of Internet hosts per 10,000 people	0.78	(2001)
Literacy rate, Total (%)	46	(2003 estimate)
Literacy rate, Female (%)	31	(2003 estimate)
Literacy rate, Male (%)	60	(2003 estimate)
Education expenditure as a percent of GNP	2.7	(1998–1999)
Number of years of compulsory schooling	5	(2000)
Number of students per teacher, primary school	55	(1999–2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. Government has developed a National IT Policy and a matching Action Plan. The theme for the policy is: "The Government shall be the facilitator and enabler to encourage the private sector to drive the development in IT and Telecommunications." To realize this vision, the following goals have been established:

[144] Adapted from Global Information Inc.

- Make the government a facilitator and an enabler to provide maximum opportunities to the private sector to lead the development of IT.
- Develop an extensive pool of trained IT manpower at all levels to meet local and export requirements.
- Provide business incentives for both local and foreign investors to ensure the development of Pakistan's IT sector (including the software, hardware, and service industries) and the use of its products.
- Develop an enabling legislative and regulatory framework for IT related issues.
- Revitalize, emphasize, and support the country's dormant manufacturing and R&D potential.
- Establish an efficient and cost-effective infrastructure that provides equitable access to national and international networks and markets.
- Set up national databases that are reliable, secure, up-to-date, and easily accessible.
- Promote widespread use of IT applications in government organizations and departments for efficiency improvement and transparency in function and service provision, and to organize and facilitate access to public information.
- Promote extensive use of IT applications in trade, industry, homes, agriculture, education, health, and other sectors with widespread use of the Internet.
- Encourage and promote the development of quality software that can capture export markets.
- Develop a tradition of electronic commerce for both national and international transactions.
- Encourage expatriate IT professionals to return to Pakistan and establish software houses, and invest their time and effort in the development of local industry and software exports.

A system of monitoring, surveying, and compiling statistics on the extent and growth of the IT sector is also be devised to provide reliable data for planning and evaluation purposes and to set up performance indicators. Ensuring that the plan meets its objectives

consistently and swiftly, a mechanism will be set up involving the government, the private sector, academia, and other national representatives to coordinate and implement the policy and plan elements and provide strategic supervision over the longer term. The IT Policy and Action Plan are dynamic documents and will be subjected to formal review under this mechanism every six months, with more area-specific monitoring carried out on a monthly basis.

ICT in Education. Core IT policy strategies have been proposed in several key areas, including the following that address education:

- **Human resource development.** Human resource (HR) development is imperative for the local IT industry to position the country as an important player in the international IT market. Under the HR Action Plan, a large cadre of academically and technically-skilled manpower will be developed to meet both local and export needs. Four new IT universities are to be established to meet this need, along with a Virtual IT University, National Testing and Accreditation Services, and an Educational Intranet. Existing IT institutes will be strengthened and faculty hired from abroad.
- **IT education.** The education sector is responsible for delivering a work force skilled in the use of information systems. Technical corps able to produce and maintain information products and services will be created through appropriate policies and incentives. IT education of those living in rural and poor areas has been made a strategic priority for both social and economic development. All universities, engineering and medical colleges, and institutions of higher learning will be networked for improved quality of education. Educational facilities will be encouraged to adopt computer-assisted learning and other IT tools. Virtual classroom education programs will be set up using online, Internet, and/or video facilities to provide DL to a large number of individuals. A compulsory, modern, and up-to-date Computer Literacy module will be included in the matriculation curriculum of high schools. To address the critical shortage of qualified IT faculty, faculty is to be hired from abroad.

- **IT training.** Investments in IT training are expected to yield quick results. Policy recommendations include (i) ensure high-quality training by assigning the Accreditation Council for IT Education the task of collecting data on training institutions, rating the institutions, and disseminating information on the institutions; (ii) strengthen existing IT training institutions and encourage establishment of new IT training institutes, update curricula, introduce new technologies through linkages with global IT firms, develop strong local faculties, and provide student scholarships; (iii) ensure maximum utilization of existing facilities, encourage public universities and colleges to collaborate with the private sector in conducting training programs during vacations and at other times when the facilities are not in use; (iv) make a special effort to train and induct women in the IT sector; and (v) make extra efforts to educate and train people with special needs.[145]

[145] For full details, please see *Information Technology Policy: Pakistan*.

Less-Developed Countries: Southeast Asia Region

The countries included in this category are Indonesia, and Brunei Darussalam.

a. Indonesia

Population	214,840,000	(2001)
GDP per capita ($)	700	(2001)
Number of mobile phones per 100 inhabitants	2	(2001)
Number of Internet hosts per 10,000 people	2.2	(2001)
Literacy rate, Total (%)	89	(2003 estimate)
Literacy rate, Female (%)	84	(2003 estimate)
Literacy rate, Male (%)	93	(2003 estimate)
Education expenditure as a percent of GNP	1.3	(1999--2000)
Number of years of compulsory schooling	9	(2000)
Number of students per teacher, primary school	22	(1999--2000)

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The government, through the Coordination Team for Telematics of Indonesia, has drawn up a Five-Year Action Plan for the Development and Implementation of ICT in Indonesia.

ICT in Education. The Five-Year Action Plan includes a program for implementation of telematics in education from 2001 until 2005, which aims to:

- Stimulate collaboration between the ICT industry and educational institutions through training and R&D collaboration, and establish a network for skill and capacity development.

- Develop and implement ICT-based curricula.
- Use ICTs as an essential part of the curricula and learning instruments in schools/universities and training centers.
- Establish distance education programs, including participation in Global Development Learning and other networks.
- Facilitate the Internet use for more efficient teaching and learning.

The Ministry of Education and the Indonesian Legislative Assembly were studying draft legislation on the National Education System, which is said to include policies and strategies for ICT in the education system, and specifically for training in ICTs.[146] In addition to the planned use of ICTs in the formal education system, the current and proposed initiatives in the education sector include:

- **Development of software in the Indonesian language.** One of the obstacles to the widespread use of ICTs in Indonesia is the relatively low proportion of people who have an adequate command of English, with the result that they are reluctant to use PCs, software, or browse the Internet. To overcome this obstacle, and to support efforts to increase ICT literacy, the government will foster the development of application programs in the Indonesian language based on Linux, an open source. As of 2002, two programs had been developed—WinBI (Windows in Indonesian Language) and Kantaya (Virtual Office)—by the Office for the Research and Application of Technologies.[147]
- **The Asia-Pacific Economic Cooperation (APEC) Cyber Education Network** is a network coordinated by the Office of Educational Research and Development of the Ministry of National Education to reduce the gap between the skills of

[146] Yuhetty, Harina. 2003. ICT and Education in Indonesia. Presentation at the UNESCO High Level Policy-Makers Workshop, Bangkok, February 18—21.

[147] Dr. Onno Purbo, a well-known Indonesian ICT expert, reports that no indigenous fonts and scripts are used, as Indonesia is currently using the western alphabet. The major problem is mainly lack of content written in Indonesian. Speak-and-listen is the common way to communicate in Indonesian culture as compared to read-and-write. Only 15.3% of Indonesian content is in Indonesian.

high school teachers in Indonesia and their colleagues in APEC countries in the use of ICTs in education.

- **ICT training in schools.** The Directorate of Vocational Education launched this program in 2001 with the objective to train teachers and students in using ICTs, especially the Internet. This activity is coordinated with the Network of School Information, a community of Vocational Schools that are Internet users. This network provides the training. In 2002, training in ICTs under this initiative included (i) CNAP training: 37 locations, (ii) Cisco equipment: 18 locations, (iii) internet networking: 572 locations, (iv) technology and information training courses and school networking: 48 locations, and (v) wide area networking: 9 locations.
- **Socialization of computer-assisted learning media** in high schools. In September 2002 the Directorate of Secondary Education conducted a training program on the use of computer-assisted learning media in cooperation with the Center for Information and Communication Technology for Education (Pustekkom).[148] This program was conducted with face-to-face interaction involving 800 high school teachers from 200 schools in 20 provinces.
- **School networking development.** The Directorate of Vocational Education has developed networking plans linking vocational schools with the following principles and programs: (i) school networking, as an institutional infrastructure, is independent and community- based, developed by and for the community; (ii) school networking is developed through a bottom-up approach; it is not centralized, and has full autonomy; (iii) school networking in 50 Regencies/ towns was planned for 2003; (iv) Regencies/ towns off Java Island are the priority; and (v) all Regencies/ towns are expected to have their own school networking in the near future.
- **Internet networking grant**. The Directorate of Vocational Education provides grants to assist vocational schools in developing their networks with the following conditions: (i) to assist the school to network 5 to 10 PCs; (ii) the maximum

[148] See http://www.pustekkom.go.id/.

grant is 10 million Rupiah[149] per school; (iii) for 2003, the grant is allocated for 50 schools; and (iv) the school should be a member of a school network in their region.

- **Millennium Internet Road Show 2002 Program.** This program was initiated by private companies in 2002. Its objective was to enhance public awareness and to diffuse ICT knowledge. It was coordinated by the Association of Indonesian Internet Service Providers with support from the media and local governments. In 2002 the Road Show covered 15 provinces.
- **National Education Information System.** This program provides information about education in Indonesia. There are 30 provinces and 16 districts connected to this network, and they collaborate to provide fast and accurate educational data.

Current Situation. The economic crisis of the late 1990s threw Indonesia's telecommunications sector into considerable turmoil. Through its subsequent signing of the WTO World Telecommunications Pact, Indonesia committed itself to eliminating and preventing anti-competitive practices in the telecom sector. Growth, both in subscriber numbers and in revenues, is occurring once again. More importantly, there are signs that the changes in the regulatory regime and the restructuring of state enterprises have started to have an impact. Fixed line telephone density was just under 4% at the end of 2002 and mobile penetration passed 5% heading into 2003. The government has also taken the first steps to remove the state-owned monopolies that have long dominated the market (footnote 153).

The telecom sector continues to evolve (albeit slowly) to a point where it is approaching a full and open competitive environment. At the end of 2003, a duopoly was in place, with PT Telkom and PT Indosat both recognized as "full service carriers," able to serve equally all segments of the telecommunication market. They access the market under various and sundry licenses that have been awarded, for the most part, without any competition or oversight. In several instances the licenses of PT Telkom and Indosat result in clear and unfair competition to other players in the market. It is expected that WTO commitments will eventually lead to full and open competition.

[149] Equivalent to about $1,200 as of February 2004.

The current ICT infrastructure is estimated to be serving only 1—5% of the population. A Universal Service Obligation Policy has been in place for several years, but it is woefully ineffective. It taxes all telecom operators, irrespective of the type of service they offer, and whether or not they are eligible to access the fund themselves. Further, the fund's primary purpose to date has been to underwrite PT Telkom's revenue shortfalls.

Nevertheless, with the growing trend of regionalization throughout the country, local and regional governments and interest groups are slowly taking matters into their own hands and bringing telecommunications services to their communities. This is opening all sorts of opportunities for local entrepreneurs to start up local operations that will eventually be interconnected or absorbed into a PT Telkom or PT Indosat nationwide network.

Basic and local call rates are perhaps among the lowest in the world. IDD[150] is still far beyond the average means at the village level. However, it is not the basic call rates that have kept service out of today's underserved areas; it is a lack of competition with PT Telkom, which has been allowed to select areas with minimal investment costs and avoid the risk of investment in remote areas.

Dial-up service over noisy lines is the predominant mode of access to the Internet. Not surprisingly, many Internet cafés as well as small businesses are likely to bypass the telephone company's last mile infrastructure using WiFi 11Mbps equipment running at 2.4GHz103, with some currently using 5.8GHz equipment for higher bandwidth. Most of the wireless access points are in cities.

Wireless infrastructure is the most probable solution for the deployment of Internet services in rural, underserved, poor neighborhoods. However, rural areas face other challenges. These include the demand factor, since the poor have little opportunity to appreciate the potential of ICTs. There are also social and cultural aspects to consider, as well as a major stumbling block in the inefficient regulatory framework. It is generally believed that education services will be the foremost driving force to bring service to remote and rural areas and thence, to stimulate demand.

The cost of an Internet dial-up connection, where available, ranges from between $10 and $20, depending on the package and

[150] International Direct Dialling.

terms. Connections through the Cable TV systems run in the neighborhood of $20 per month, but can be lower, depending on the combined Cable TV/Internet package subscribed to. Cable Internet is the premium service and as different in quality as day and night compared to the wire line connection. Most wire line connections are extremely slow and very unreliable once a particular service becomes known and popular. Schoolteachers, especially those in the villages, are among the lowest paid "professionals" in the country. It is not unusual to hear of a teacher's monthly salary being in the neighborhood of $50, with perhaps shelter of some sort thrown in. As a result, the cost of an Internet connection is prohibitive for educators.

Outside of Cable—with approximately 250,000 subscribers nationwide, of which more than 50% subscribe to both cable TV and the Internet—there is very little other broadband service available. The situation is expected to evolve rapidly, especially in some of the currently underserved but relatively wealthy regional economies. The demand for services is very strong and it is simply a matter of time before a major investor takes the risk.

As of 2001, according to the Association of Indonesian Internet Service Providers, there were an estimated 2.3 million PCs in the country. Most of these, about 1.9 million, were in business and government. The Association also reports that there were only about 251,000 PCs in Indonesian households, and the over 60,000 educational institutions had only about 58,000 PCs among them.

There were an estimated 2 million Internet users at the end of 2001, out of approximately 600,000 Internet subscribers. Over 70% of Internet access is through more than 1,500 Internet cafés, which are more affordable for Indonesian communities at rates that range from $0.30 to $1 per hour. Connections in tourist areas, such as Bali, can reach $5 to $6 per hour.

b. Brunei Darussalam

Population	335,000	(2001)
GDP per capita ($)	15,060	(1998)
Main lines per 100 inhabitants	25	(2000)
Main lines per 100 households	149	(2000)
Number of mobile phones per 100 inhabitants	29	(2000)
Number of Internet hosts per 10,000 people	260	(2001)
Literacy rate, Total (%)	92	(2003 estimate)
Literacy rate, Female (%)	89	(2003 estimate)
Education expenditure as a percent of GNP	3	(1998)
Number of years of compulsory schooling	12	(2000)
Number of students per teacher, primary school		13 students

GDP = gross domestic product, GNP = gross national product.
Sources: ITU-D Country Database and Encarta 2003.

ICT Policy. The Authority for Info-communications Technology Industry (AiTi) of Brunei Darussalam commenced operations at the beginning of 2003. AiTi is the statutory body responsible for developing and regulating Brunei's ICT industry, which includes the management of the national spectrum. The AiTi Vision is to provide Brunei Darussalam with a dynamic, innovative, and vibrant ICT industry that is anticipative to the needs of the nation and responsive to the challenges of the information era. The AiTi Mission is to:

- Ensure the supply of a reliable, affordable, and accessible ICT services to the public.
- Contribute toward economic development of the country by being more competitive, and to encourage the flourishing of local companies in this sector.

- Provide a regulatory framework that enhances effectiveness, efficiency, and accountability of players in the industry.
- Represent the country at international forums in order to sharpen the competitive edge in the industry as well as keep abreast of international changes and development.
- Ceate an environment conducive for the participation of individuals and all sectors, as well as the enhancement of skills, in the ICT industry in Brunei Darussalam.

AiTi has several Key Thrust Areas that reinforce its Mission statement:

- Licensing regime and regulatory framework.
- Promoting ICT development.
- Human capacity building for ICT.
- Advisory role on ICT.
- Digital divide and universal access.

ICT in Education. This topic comes under the Human Capacity Building for ICT rubric in the AiTi Vision. Objectives are to:

- Accelerate the development of emerging, critical, and specialized IT skills to satisfy requirements for highly skilled manpower to spearhead the ICT industry in Brunei Darussalam.
- Assist ICT professionals to meet the dynamic challenges of the new knowledge-based economy through relevant training courses evaluated and endorsed by AiTi.

The government has spent a total of 20.7 Brunei million[151] in the implementation of three phases of ICT initiatives. The Minister of Education claims that almost all the government primary and secondary schools have been equipped with computer hardware, software resources, and ICT competency training for teachers and

[151] Equivalent to $12,138,627 as of 16 December 2003.

administrators, and that soon all schools will be connected to the Internet and will access the wealth of appropriate and relevant information on the World Wide Web.[152]

The Minister also maintained that with e-government initiatives, such as the e-education flagship, an estimated total amount of 145 million Brunei dollars would be spent under the 5 pillars of strategic ICT components by 2005 namely: Edunet, E-Learning, Education Information System, Digital Library, and Human Capacity Building. He added that the average state budget for education in Brunei Darussalam amounts to 564 million Brunei dollars out of the 4.51 billion Burnei dollar annual budget, reflecting the government's strong emphasis on the importance of education in Brunei Darussalam, and resulting in a literacy rate of 93.7 percent.[153]

Current Situation. In June 2003, an article in the *Borneo Bulletin* reported that actual progress was substantially different from that reported by government sources. The report states that while neighboring countries are on a fast track to reach the high ground of ICT, Brunei Darussalam appears to be struggling to achieve its objectives, despite the much-publicized determination to make the nation and its people ICT-savvy. It goes on to say that while countries like Singapore and Malaysia are advancing with the rest of the world in the ICT arena, Brunei seems to be moving at a snail's pace.

Currently there are two service providers in Brunei Darussalam: Jabatan Telekom Brunei (JTB), a fixed line provider, and DST Communications Sdn Bhd, a GSM service provider. JTB, which is under the Ministry of Communications, will become the corporation,Telekom Brunei Bhd.

[152] The Minister made the remarks while officiating at the ASEAN-EC International Conference 2003 on the K-Economy: "Competitiveness, Survival and Growth."

[153] Adapted from Government of Brunei Website at http://www.rtb.gov.bn/NewsUpdate/2003/October 03/091003/.

IV

ICT INITIATIVES IN ADB EDUCATION PROJECTS

A. The Projects and the Scope of Evaluation

This review covers loan and TA projects in the education sector that were approved or under formulation by ADB during the period from January 2000 to March 2004.[155] The use of ICTs in education, and more broadly where possible, in human development generally, are assessed in an evaluation of the planning and intent of 8 loans and 11 TA projects, the details of which may be seen in Appendix 1. The efficiency and effectiveness of the implementation of these projects and their impact could not be evaluated because nearly all were still under implementation in 2004. Thus no project completion reports or project performance audit reports—providing complete evaluations of project implementation and impact—had yet been completed for these projects, and files of ongoing projects are confidential.

Similarly, the scope of this review did not allow assessment of ICTs in ADB projects in other sectors—whether ICTs were introduced; whether the introduction of appropriate ICTs would have provided beneficial leverage to the success of a project; and whether they benefited from investments in ICTs in the education sector. Such investments should inevitably benefit all social sectors.

B. Evaluation Checklists

In planning and evaluating ongoing and proposed ICT initiatives, a common set of guidelines, commonly known as an Evaluation Checklist, should be used. From several models currently available, we have selected and modified the Australian guide as being perhaps more germane for the Asia-Pacific region. With the exception of the priority placed on the enabling framework and the building of local capacity—which come front and center on ITU, North American, and World Bank funded project checklists, this checklist is not substantially different from those adopted in Canada, the US, the UK, and other developed countries and within donor organizations. Another minor difference, perhaps, is the order of components and the level of detail of the specific issues to be addressed.

ICT-Driven Projects

Project planning and evaluation at the outset must take into consideration whether the project is ICT-led, or supported by ICTs. Checklist 1 below is for use with an ICT-driven project. This refers to a project where some aspect of information and communication technology is a lead component of the project. A second checklist is provided in the next section of this paper for use with projects where some aspect of ICT may be used as a means to an end, but the use of ICT is not a major component of the project.

In planning a project in a developing country using ICT as a lead feature, the checklist of 10 questions in Table 7 will help to assess its value as a tool for contributing to the development process.

Table 7: Good Practice Guide to the Design of ICT-Driven Projects

Component	Issues to be Addressed
	Questions for ICT-driven projects on reducing poverty as identified through the MDGs[a] and indicators:
1. Is the objective of the ICT-based project aimed clearly at achieving a specific poverty reduction goal?	Goal 1: Eradicate extreme poverty and hunger • Does the ICT project reduce poverty and hunger by providing access to better or more reliable income earning opportunities for those on the lowest incomes? • Does the ICT project reduce poverty and hunger for those on the lowest incomes by promoting rural development/agriculture?· Does the ICT project improve government service delivery in health, education to those on the lowest incomes? Goal 2: Achieve universal primary education • Does the ICT project increase numbers of young people who complete primary education? • Does the ICT project reduce illiteracy among 15 to 24 year olds? • Does the ICT project improve gender equity at all levels of education? Goal 8: Develop a Global Partnership for Development • Does the ICT project improve the prospects of decent & productive employment for young people 15 to 24 years? For women? For heads of families?
2. Is there a clearly-specified target groupfor poverty alleviation?	• A clear understanding is needed of the target group or groups to whom the project is directed. • The ICT-based project needs to show it is directed at meeting the needs of the poor. In most cases, this refers to those in rural areas. It can also refer to the poor among the urban population or specific groups, such as women among the rural or urban poor. • More specific target groups of the poor within geographical areas may need to be identified in middle-income countries. • A good knowledge of the target group's information needs is also needed. This can best be obtained by encouraging a representative group from the target population to define their own information needs—e.g. trainers of educators for remote schools. • Other sources of information may also be needed to ensure that narrow self-interest has not dominated the results of the participatory data collection.

[a] See http://www.developmentgoals.org/About_the_goals.htm.

Table 7: Good Practice Guide to the Design of ICT-Driven Projects
(continued)

Component	Issues to be Addressed
3. Is the form of ICT to be deployed appropriate in terms of cost, support, maintenance andcompatibility with existing information flows?	Appropriate form of ICT • Is there an enabling policy and regulatory framework in place? If not, what alternative supporting mechanisms are available? • Are there best practices elsewhere that have proven that the technology is appropriate to the country's social, physical, economic, and political environments? • Is the project complementary to—and supportive of—the national ICT and education policies and strategies? • Have local stakeholders been intimately involved in the planning, design, implementation and delivery of the project? • Is the form of ICT to be deployed appropriate in terms of cost, support and maintenance? • Is the new form of communication compatible with existing information flows? Appropriate forms of ICT refer to effective combinations of low-cost and innovative technologies. Important design features are: • simple configuration, operation, and maintenance; • user friendliness; • equipment and software comply with international and local technical standards and they are compatible for interconnection to other systems; • use of appropriate radio communications frequencies; • robust and durable equipment with low total cost of ownership; • capacity for remote network management; • low power requirements; and • easily upgradeable hardware and software elements.
4. Is the form of ICT to be deployed scalable to enable it to be replicated and expanded?	The ICT-based project, if it is to be more than a pilot, has to have the capacity to grow by extension into other geographical areas, and to be replicated in other locations or settings so that its success can be extended. This requires not only paying attention to the technical specifications of the equipment used. It also refers to consideration of: • the capacities and reach of the supporting infrastructure, • the compatibility with systems that feed it and with those that will carry it, • the availability of management and technical skills in other locations, and

Table 7: Good Practice Guide to the Design of ICT-Driven Projects
(continued)

Component	Issues to be Addressed
	• the supporting policy and regulatory framework related to the use of ICT.The principle of scalability refers to the capacity of the project's design to operate on a national level, able to meet the challenges that this would involve.
5. Are appropriate intermediaries being used?	The need to use intermediaries is a key element of the successful use of ICT in development. Intermediaries refer to the contributed international experts and to those with direct ties to the beneficiary community. • Do the international consultants have extensive practical experience in similar situations or is their knowledge mostly theoretical and academic? • Do the international experts have access to extensive backstopping to provide in-depth technical information that may not be available locally? • What is the motivation of the intermediaries? Will they gain economic reward tied to the quality and quantity of services they provide?
6. What scope is there for public-private partnerships?	• Partnerships can involve private enterprises, governments and non-government organizations. • Potential partners include domestic enterprises, local NGOs, international corporations, and multilateral agencies. • If a private or public partnership is supported through donor contributions, how do you ensure that this would not be fostering a monopoly situation to the detriment of potential beneficiaries? • What leverage is available to bring partners back into line in case of less than expected performance?
7. Is the content transmitted by the ICT relevant to the audience and is it in a language and format easily understood by the target audience?	Language, culture and content • Is it in a language easily understood by the target audience? • Is there readily available, interesting, and relevant generic content from other sources that can be localized and distributed at the onset to build up a client base? • Are there local traditions, events, music, and performances that could benefit from this project? • Is the content transmitted by the ICT project relevant to the audience? • The lack of availability of content in the local language can be a key barrier to the effective use of ICT for development.

Table 7: Good Practice Guide to the Design of ICT-Driven Projects
(continued)

Component	Issues to be Addressed
	• Where there is relevant information in a local language, it may still need to be tailored for use at the village level. • Local research involving direct engagement with the local population is often needed to work out what is relevant information. • Two-way communication needs also to be incorporated into the project for feedback to ensure that genuine understanding can take place and is demonstrated.
8. Is the project self-sustaining, and over what period?	Sustainability refers not only to financial viability, but it also includes continuing organizational, social, and political support. The reasons for non-sustainability can often be traced to insufficient consideration of the challenges faced. These may include: • little or no support (buy-in) in the local community from key stakeholders. • lack of an appropriate national policy structure, and/or • poor appreciation of the physical, economic and educational barriers at community level to the effective use of ICTs.
9. How is the project to be monitored and corrective measures applied when needed, and how are results to be measured?	• Monitoring performance and evaluating is essential to show how well the project's objectives are being achieved. It is the way to learn from experience. • Monitoring and evaluation requires the participation of stakeholders and beneficiaries to get their feedback on whether the project is achieving what it claims to be • Evaluation results also need to be made available in a variety of formats for different target audiences

ICT-Supported Projects

When planning a development project, and there is a need to determine the value of incorporating an ICT component, the steps in the checklist in Table 8 will help plan how best to approach the task. The purpose of these 11 steps is to clarify what it means to integrate information and communication technologies into a development

Table 7: Good Practice Guide to the Design of ICT-Driven Projects
(continued)

Component	Issues to be Addressed
10. What unexpected events or situations might arise? and What should be done to manage these?	• Delivering an aid program is an inherently risky venture. An ICT-based project is likely to compound the risk. This is due to the technical difficulties that are an inherent feature of ICT in its constant state of evolution and the limited access to real expertise to help solve problems in a developing country. • Many development activities fail to live up to expectations. This applies particularly to ICT projects due to the widespread hype about the new technology's potential. • The key questions for a donor in identifying and managing risk are: 'What unexpected events or situations might arise?' and 'What should be done to manage these?' • The risks involved at each stage of the activity cycle of a project need to be identified and managed. For more details, visit AusGUIDE, 2001, Activity Cycle Overview. • The potential risks for all the stakeholders involved need to be identified. This refers to the potential risks for the recipient government, the community targeted for the program, and the service deliverers or other intermediaries. • In relation to the targeted poor, one risk factor to consider is whether the project is likely to exacerbate local inequalities or increase tension between ethnic or religious groups. • A critical factor is the absorptive capability of the local champions in being able to cope with the unexpected and applying appropriate solutions on their own initiative.

ICT = information and communication technology, MDGs = Millennium Development Goals.

project. Poverty reduction is chosen as a focus to illustrate the proposed steps for two reasons: poverty reduction is likely to be the objective of many projects; and a focus on poverty reduction highlights the value of not considering ICTs as ends in themselves, but as a means to an end.

Table 8: Good Practice Guide to the Design of ICT-Supported Projects

Component	Issues to be Addressed
1. Define Project objective: In terms of poverty reduction, what aspect of poverty does the project address?	Poverty has many dimensions. These include lack of basic income and regular experience of hunger, no access to basic education or health care, especially for children and mothers, exposure to HIV/AIDS, malaria, and tuberculosis, and lack of access to jobs for young people.
2. Who are the poor tobe targeted by this program? To what extent is it possible to identify the poor in terms of rural/ urban location, region, gender, age, education attainment & health status?	• To what extent is it possible to identify the poor in terms of rural/urban location, region, gender, age, main source of livelihood, education attainment, health status? • This profiling requires the availability of comprehensive data sources such as census data, a large sample representative sample survey, or good quality administrative data at the local level. • It may be sufficient, however, in countries with a low average per capita income, to use only two dimensions to identify broad target groups of the poor. • In low-income countries, examples of the two dimensions are location and gender—for example, women in rural areas, or women in a particular region notably poorer than other regions.
3. What are the likely causes of the aspect of poverty the program is focusing on? Try to rate the likely causes in order of importance? Is poor communication one of the causes?	• What are the likely causes, as distinct from the effects, of the aspect of poverty the program is focusing on? • Is it possible to rate the likely causes in order of importance? • Is poor communication a cause of this aspect of poverty? > Identifying the likely causes of the particular type of poverty under scrutiny is essential to work out the best point of intervention. > A focus on possible causes helps to ensure that the project is not merely alleviating the symptoms of poverty. For example, looking for the causes of hunger may require going beyond the obvious, such as poor nutrition, to look for more fundamental causes, such as a lack of access to productive land or other critical resources. > This process of assigning order of importance to the likely causes may be difficult, but it holds the promise of achieving a more permanent impact.
4. What types of interventions are most likely to be	What types of interventions are most likely to be effective in addressing the causes of poverty? Try to distinguish between direct, indirect, and supporting interventions.

Table 8: Good Practice Guide to the Design of ICT-Driven Projects
(continued)

Component	Issues to be Addressed
effective in breaking the causal linkages? Need to distinguish between direct, indirect, and supporting interventions.	• A **direct intervention** refers to addressing a prominent underlying cause of poverty. For example, providing access to other income generating opportunities in the above case where hunger is caused by lack of access to a sustainable livelihood. • **Indirect interventions** seek to establish an environment or set up an intermediary to make the directly targeted interventions more effective. Examples of indirect interventions include: > Financing public health facilities. > Establishing a sound policy and regulatory framework for credit facilities. > Undertaking agricultural research appropriate for small farmers. > Supporting interventions may not provide any direct linkages with the target population but may, nevertheless, benefit the poor by helping them to reduce their poverty. > Policy reform of how government services are delivered by making the service delivered more accountable and transparent is an example of a supporting intervention. Systems that promote more effective service delivery, such as help the poor gain better access to basic education or health care. • Identifying the likely causes of the particular type of poverty under scrutiny is essential to work out the best point of intervention. • A focus on possible causes helps to ensure that the project is not merely alleviating the symptoms of poverty. For example, looking for the causes of hunger may require going beyond the obvious such as poor nutrition to look for more fundamental causes, such as a lack of access to productive land or other critical resources. • This process of assigning order of importance to the likely causes may be difficult but it holds the promise of achieving a more permanent impact.
5. What are the information and communication needs of the targeted poor in relation to the project's objectives and how important are they to the success of the project?	• What are the information and communication needs of the targeted poor in relation to the project's objectives? • How important are they to the success of the project? • In relation to the success of the project, are meeting the information and communication needs of the poor crucial, valuable but not essential, or are they peripheral?

Table 8: Good Practice Guide to the Design of ICT-Supported Projects
(continued)

Component	Issues to be Addressed
6. What role can ICT and other media play in delivering the information and providing channels of two-way communication?	• What role can information and communication technologies, broadly defined, play in providing channels of two-way communication? • What role is there for ICT to meet the communication needs identified in Step 5? • Is the use of ICT likely to play a central role, an important but not central role, or a peripheral role?
7. Is there an appropriate form of ICT, which can be deployed in terms of cost, support, maintenance, and compatibility with existing information flows?	• Is there an appropriate form of ICT, which can be deployed in terms of cost, support, maintenance, and compatibility with existing information flows? • Is it possible to combine several ICTs to deliver the desired cost-effective outcome? • For example, it may be important to have a final link, which is low cost, such as a community radio outlet, and radios using renewable energy sources. • Is equipment locally available to replace parts easily and provide maintenance support? • Is the use of ICT compatible with existing information flows shaping how the targeted poor communicate?
8. Does an enabling environment exist for the ICT to provide the proposed support?	• The enabling environment for the use of ICT refers to the regulatory framework. It also refers to government practice, such as a whole-of-government strategy to improve service delivery. • The sorts of issues that may be important are: national telecom policy and legislation; availability and reliability of infrastructure, such as electrical power sources; availability of local training in ICT literacy and maintenance skills; and agreed changes to education and health delivery to make use of ICT. • One way to locate the gaps in the enabling environment is to bring together a group of stakeholders and use a brainstorming methodology to identify the issues or problems and what needs to be done to change the situation.

Table 8: Good Practice Guide to the Design of ICT-Driven Projects
(continued)

Component	Issues to be Addressed
9. What measures can be devised to assess progress toward the poverty reduction objective?	Examples of possible measures are the indicators used to assess progress for attaining the MDGs. It is important that progress measures report outcomes in some way rather than merely a project's inputs and outputs, or its processes.
10. Is there a methodology in place to assess how effective the proposed intervention is in achieving the operational objectives of the program?	• Is there a methodology in place to assess how effective the proposed intervention is in achieving the objectives of the program? • An evaluation strategy needs to be in place to provide feedback on how well the project is meeting its objectives. • Good information about what is working and what is not in relation to poverty reduction is an essential requirement for fine-tuning future strategies.
11. What unexpected events or situations might arise? 'What should be done to manage these?	• What unexpected events or situations might arise? • What should be done to manage these? • Identifying potential risks and development of appropriate strategies for managing the identified risks is also an essential part of project design. • It is important to identify the risks from the point of view of all stakeholders involved and not merely the donors. Other important stakeholders are the recipient government, the community targeted for the program, the service deliverers, and other intermediaries.

ICT = information and communications technology, NGO = nongovernmental organization.

C. Evaluation and Observations

Priority was placed on identifying and reviewing projects with a significant ICT component, and not projects where ICTs are used simply as a support or implicit function—such as acquisition of computers for administrative purposes, setting up a modest management or record keeping facility, or part of a set of skills development. In some projects examined, a distance education system is to be established, but available documentation does not reveal whether this is to be online or passive DE—such as DE using the postal system. It was assumed there was a degree of electronic leverage to be considered in such projects. Additionally, some projects were examined that are not specifically in the education sector, but that cut across all sectors of a national or regional economy and are enabling in nature, with carriage and delivery of education frequently a priority service. The TA projects in the Maldives (MLD 34276-01) and in the Pacific (5990-REG) are of this nature(see Appendix 1).

Few of the projects reviewed drew inspiration from the ADB ICT Strategy, in that seldom was there an assessment of the enabling policy and regulatory framework, or of local e-readiness, including absorptive capability, in the project description. The notable exceptions were the previously mentioned projects in the Maldives and the Pacific, as well as a project in Samoa (TA SAM 36513-02) and one in Sri Lanka (TA SRI 33251-01).

The project review process revealed a significant number of major projects where the opportunity to use ICTs to facilitate training or decentralization was missed. This is especially critical when administrator and teacher training is involved, since teachers are on the front line as champions in helping to carry the national educational system into the knowledge economy. Today, it is difficult to imagine a preference for exclusive use of traditional printed materials and pedagogy when it is painfully obvious that secondary school graduates will require proficiency in ICTs in most occupations to compete successfully for meaningful employment anywhere in the world.

In some cases, successful outcomes of projects reviewed were difficult to visualize, since consultant eligibility was restricted to domestic firms, when there were no precedents in the project country for the fairly complex operations called for under the project.

Most of ADB investments in ICTs do not appear to blend naturally and uniformly into the mainstream of ADB activities, which are still largely focused on physical infrastructure, such as roads, power, and transportation.[154] Much of this may be attributable to the limited exposure of individual project officers to the benefits ICTs in their area of expertise. EC meta-evaluation of European donor agencies' use of ICT in development noted that the ICT dimension of programs in governance, poverty, etc, was often subject to the discretion of individual officers. If there is a parallel situation in ADB, incorporating ICT in mainstream programs may depend largely on individual officers' understanding (or lack) of the potential of ICTs. In the EC, this piecemeal approach led to a highly variable result, restricting opportunities to make good use of ICT in development. The overall effect was a disjointed approach to ICTs by development organizations overall.

In any institution, champions can play a key role in smoothing the introduction of new ways of working. ICT champions are found in most ICT-based projects, helping to adapt the new technology to the development context and facilitating organizational learning. There is obviously scope for ICT champions to play the same role within all donor agencies. In this context, it is interesting to note that more than half of ADB projects with substantial ICT components were in the South Asia region.

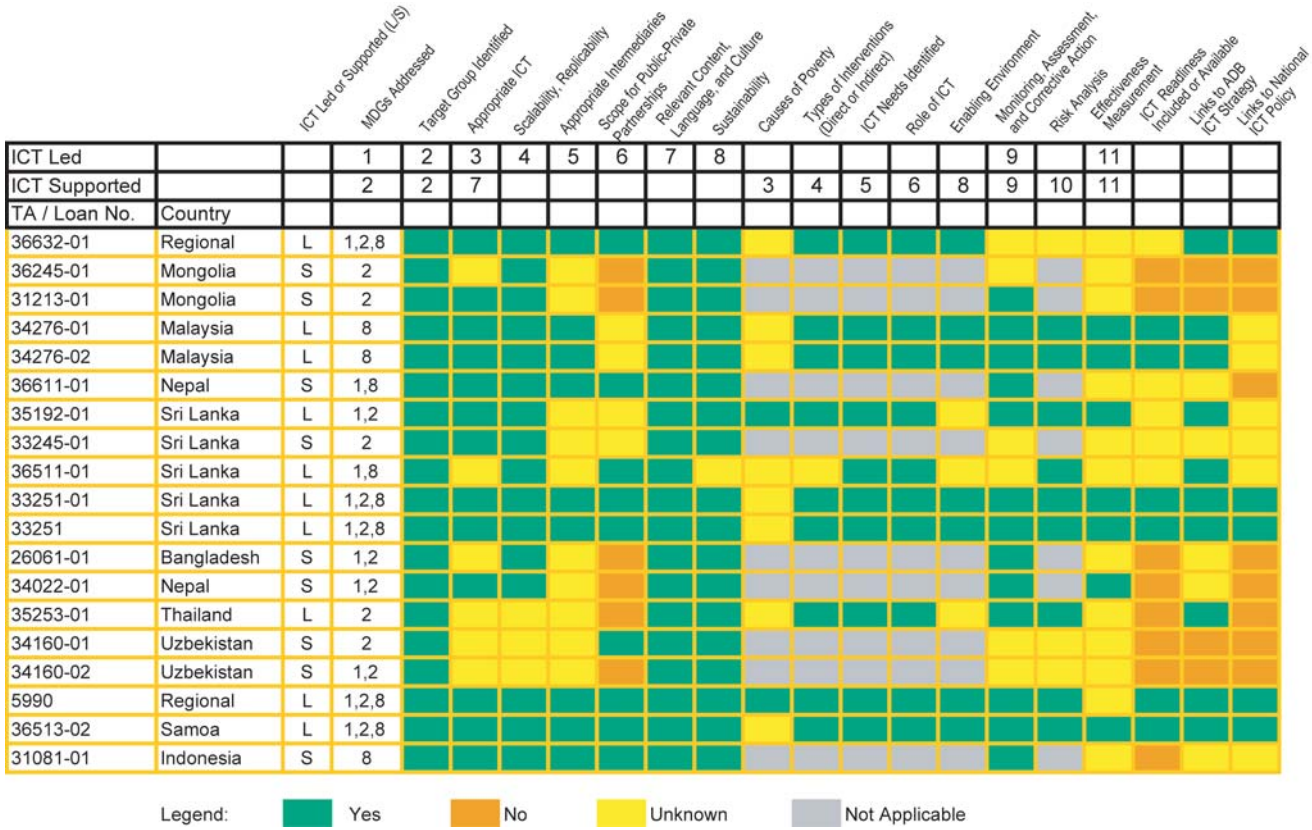
Another way to diffuse new perspectives in an organization is to set up a "community of practice." This can be done through face-to-face meetings (such as "brown bag" lunchtime seminars, for example). However, the obvious way to keep up is through an electronic discussion list. This can be used to share knowledge, experiences, and ideas among development practitioners and others. The discussion list could be kept internal to the donor organization or it could be broadened to include practitioners in the field or researchers working on the same issues. The challenge for the champions of ICT in development is to seek out and highlight the lessons of the initial pilot, or "installation," stage to achieve a turning point for progress to a more synergistic and mature "deployment" stage. Regular, focused communication needs to be at the center of any strategy to achieve that turning point.

[154] Almost half of the amount of new public sector approvals in 2002 went to the energy, industry, and transportation and communications sectors. The agriculture and natural resources, and social infrastructure sectors accounted for 20%. Source: ADB Annual report on loan and technical assistance portfolio performance for the period ending 31 December 2002.

The evaluation grid, Figure 4 below, has been constructed from information available in the project summaries of the projects reviewed. It is possible that elements that are indicated as missing have been included in the project, and this fact is not reflected in the project descriptions. Future project summaries, if they follow guidelines in the ADB's ICT Strategy, would undoubtedly address these issues as appropriate.

Three critical considerations have been added to Checklists 1 and 2 (above) when reviewing the 19 projects, and are included in the Project Evaluation Grid below: i) whether an ICT readiness study of the project country was included in the project, or was available from ADB or alternative sources; ii) whether there were obvious links to ADB ICT Strategy, and iii) whether the project traces links to the client country's national ICT Policy.

Figure 4: ICT Project Evaluation Grid



ADB = Asian Development Bank, ICT = information and communications technology, MDG = Millennium Development Goals, TA = technical assistance.
Source: CAELIS International, March 2004

V

TOOLS FOR FORMULATING ICT COMPONENTS AND PROJECTS IN THE EDUCATION SECTOR

A. Challenges and Approaches in the Use of ICTs in Education

The Policy and Operational Environment

Successful introduction of any technology or any innovative way of doing things better in the education sector depends to a large extent on an enabling policy environment coupled with a well-structured and logical implementing framework. A truly enabling environment incorporates certain important characteristics that are most often a challenge to instill.

Personal commitment of key stakeholders. Elected and appointed senior officials, administrators, and practitioners must be familiar with the advantages, challenges and limitations that are part and parcel of integrating IT into education. It is critical they to take into consideration the cultural and social ramifications of ICT in education, and realize that simply ordering, distributing, and installing computers in schools is a recipe for disaster.

Invest in the human component first. It is absolutely essential to dedicate the necessary time and effort to preparing the groundwork

with local champions—especially teachers and administrators. They must be involved in the process at the very outset to make sure that when the appliances and content arrive, they are received in an environment that is comfortable, knowledgeable, and hospitable, and they are appreciated as instruments to leverage teaching skills—not as objects of a mysterious cult of knowledge practiced only by IT experts. There have been too many unfortunate accounts of major procurements of PCs sitting in warehouses, or lying useless on desks or in spare rooms waiting for repairs, software, or a kindred soul who knows what to do with them. Such experiences have negative results that go far beyond the misuse of scarce resources. Since the prime local movers of ICT in education may be blamed for the failure of the project, such setbacks cause people who would normally be champions in their area of influence to be much more circumspect toward similar future ventures. ICTs' tainted image may extend to officials in other ministries, parents, administrators, etc., and may take years to alter.

Get fully qualified people involved. Another obstacle to success is the selection of poorly qualified experts to support the introduction of ICT in a new environment. In a major Caribbean country, the InterAmerican Development Bank extended a loan for the computerization of schools. The international experts selected to plan and implement the process had stellar academic records, but little in the way of practical applications of ICTs in schools, and no real hands-on experience. Teachers were trained on the benefits of ICT, and on applications that came with the PCs. About a month after the consultants finished their assignment, most of the computers were reported to be non-functional by the teachers, and they quickly reverted to their old ways. An investigation by the PC supplier revealed that, among many problem areas, the teachers simply turned off the power switch of the PCs at the end of their own period of use, and could not "find their programs" when they turned them on again the next day. They had little or no practical knowledge of the PC's utility in a learning environment.

There must be a spirit conducive to change. Officials of the local executing agency, including the policy experts, key administrators, and influential teachers must have a sound appreciation of the process and expected results. They must be personally convinced that the

introduction of ICTs in the learning environment needs to be well supported to ensure that the new technologies will not be used to simply extend or replicate a traditional classroom model, but rather to fundamentally change the instructional paradigm, with ICTs serving as levers for system-wide curricular reform and educational change.

There must be acknowledgement that the management of change is a major component that must be absorbed by the key participants in capacity building. In the great majority of projects that introduce ICTs to an existing organization, it is assumed that management and staff will somehow be dragged along by the flow and this will eventually transform them by osmosis into advocates of the technology. This is seldom true. People develop over the years work habits, procedures, and personal ways of getting desired results in an environment where nothing is really pressing. In an ICT-enabled world, such variables as information that is of poor quality and stale, incompetent management, and a focus on process rather than results for the client quickly become apparent. There must be realization that the human institution and its machinery must be renewed in a structured way. The key individuals involved must be carefully trained on how to bring about significant improvements in their own workplace and to nurture similar improvements among their peers and subordinates.

The Social Environment

ICTs can contribute benefits to such diverse issues as life skills, basic literacy, and technological literacy, even among the poorest. But there are often challenges in the social environment to successful introduction of ICTs.

Lack of homogeneous clusters of client population. Poor people in developing countries often are dispersed, and comprise disparate groups of youths and adult learners. Distance education through ICTs can be an effective tool in this context.

Teachers often are inadequately trained and supported in poor regions. ICT-supplemented teacher training becomes crucial in such regions in order to improve teaching and student learning.

The poor do not easily fit into a structured system. Many of those targeted for educational improvements or expansion are unable to attend traditional classrooms and/or are too old for the formal school system. The interactive and asynchronous nature of ICT can provide useful solutions in this context.

Information has to be conveyed in a manner that can be understood and appreciated. The diversity of poor people in terms of ethnicity, language, gender, etc. requires the kind of social group focus that, when properly employed, is potentially far more effective using ICT than in the traditional classroom. Even teachers that are very capable may lack, for example, the language skills necessary to be effective with poor, minority-language learners.

Knowledge should be available to clients in an environment that is comfortable to them. Some noteworthy national programs include the UK's Online ICT Centres and the Wired up Communities Programme. The latter is piloting home access to ICTs in the most disadvantaged communities. The key finding in planning this initiative was that in order to reach the most marginalized people, ICT-supported learning should take place in comfortable, "home away from home" surroundings. Individuals who had a bad experience in school may not want to take courses in the traditional classroom setting. The most effective approach is to host people to learn about ICTs, and how to use ICTs for their own benefit, in very informal, peer-led environments. Instruction starts with a focus on students' personal interests, leading a guided tour of the Internet.

The Educational System

a. At the Teacher Level

Time availability. There is seldom enough time allocated for both formal training and self-directed exploration, and for using applications to develop content and other resources for classes. This barrier can be addressed by providing the teacher with a good standard foundation course that can be progressively enhanced by experience and self-instruction supported by periodic assessments. Class preparation time can be allocated, as can specialized resources within

the school—such as course authors, multimedia developers, and instructional design experts—to help the teacher migrate his or her materials to an ICT environment. Two models that can be evaluated are that of Hong Kong, where the teacher can be trained to do everything in an autonomous way, or OLA, where support modules and specialized expertise are available through the organization so that the teacher can focus almost exclusively on the empowerment of the learner.

Self-confidence in using ICTs has not been built up enough. This is often the case when computers are acquired without preparing the human element well in advance. Again, this is attributable to a lack of basic training and familiarization for the teacher, who should be the classroom and community champion for the successful introduction of ICTs.

Negative experience with ICTs in the past. This barrier can best be overcome by peer group support. Technologies have evolved to the point that teachers can often become productive with a few hours of familiarization; they can work outward from a successful and user-friendly core application, such as Ten Minute Publisher and others available from Cisco and HP. A community of peers with similar interests and making use of standardized applications becomes a fertile nurturing ground for neophytes or for those whose previous attempts were unsuccessful.

Fear of embarrassment in front of pupils and colleagues, loss of status, and an effective degrading of professional skills. This arises when there is no supporting environment, such as in an isolated school. Possible solutions include individual adjustments to welcome inevitable change, and delegation of some responsibilities to support staff and learners who may be more competent with technology. This would mean that the success of the class depends not on the teacher, but on the teacher's team as a whole.

Classroom management difficulties when using ICTs, especially where pupil-to-computer ratios are poor. This is a frequent barrier even in developed countries. While the teacher supports those who need help the most, the more competent and adventurous are browsing areas that are not related to the class effort, and distract their

peers. This can be solved to everyone's advantage by encouraging the fast learners to guide groups of peers in assignments and learning. This approach, in addition to multiplying the teacher's presence, stimulates competition for success between groups of learners.

Inadequate teacher knowledge to resolve technical problems when they occur. The teacher should not be wasting time and getting frustrated with appliance and software problems. If local technical support is inadequate, then the ICT environment must compensate by offering either networked PCs with server-based applications that are in "deep freeze" or are self-monitoring and healing, or PCs with ROM-based applications where the user cannot modify the applications.

Personal inability to cope with change. This barrier can best be surmounted by organized professional training in change management, preferably in a peer group of teachers with varying degrees of resistance to change.

Perception that technology does not enhance learning. Fortunately, the proponents of this view are dwindling in numbers rapidly. This view remains common in developing countries, however, where there is limited exposure, if any, to ICT-enabled applications. There are a number of possible solutions, including demonstration projects using internationally-proven best practices. A model such as that proposed by ADB's Center for Learning, Information, Communication, and Knowledge (CLICK) would be most beneficial to support large-scale projects involving ICTs in poor countries. Alternatively, stand-alone CDs can provide captivating illustrations of highly effective ICTs that work.[155]

Lack of motivation to change long-standing pedagogical practices. This is a common problem in countries with a socialist history where individual resistance and incompetence is generally tolerated, and performance measurement is not welcome. There is usually stronger focus on process than substance, and the situation is magnified where the tradition of tenure is still strong. Both positive

[155] For an excellent example, see How Things Work at http://howthingswork.virginia.edu/ and How Stuff Works at http://www.howstuffworks.com/.

and negative corrective measures can be brought to bear, and these are well documented in pedagogical literature.

Perception of computers as complicated and difficult to use. There is some justification to this view, especially where there has been little preparatory training of teachers and where they have not been involved in the planning process. This situation is compounded by poor selection of appliances and software. The use of the PC should more enjoyable to use than a book for both teacher and learner. Again, this barrier can be addressed by proper training and exposure to demonstration projects, especially where a hands-on capability is available.

b. At the School Level

Lack of ICT equipment, and the cost of acquiring, using and maintaining ICT resources. This issue is directly related to political commitment, discussed earlier. If there is no policy support, dedicated school administrators are often compelled to approach parents and other sponsors to acquire the required equipment and software. Since this method is not part of a planned, holistic strategy, many gaps arise that are not evident at the outset. PCs will be supplied with basic operating and office applications, but no allowance for software that will help teachers deliver knowledge, nor is there usually technical support to keep the appliances operating smoothly. Even when state-of-the-art PCs are supplied, the total cost of ownership (TCO) has seldom been taken into account. This barrier can only be addressed properly by a strong and knowledgeable political commitment, backed by appropriate resources, and recognition that teachers must teach, not become less-than-efficient maintainers of appliances. Acquisition, software, maintenance, and updating expenditures can be minimized by planning for protected and remotely administered PCs networked to central locations. This is much simpler and economical than the image conveys, and can be accomplished elegantly even under the most difficult conditions by using modern technologies, such as cacheing and remote monitoring and support for technical and content issues.

Poor access to ICT equipment due to organizational factors, such as the deployment of computers in ICT labs rather than in

classrooms. This problem is often due to scarcity of resources, where a school with limited facilities will wish to protect them and make them available under controlled conditions to the largest possible number of users. Time combined with a good track record with users may well result in budgets providing for additional resources. Where poor access is a function of poor planning, there should be a gradual change toward distributed access in the classroom. In cases where the problem persists—such as administrators reserving PCs in their offices as status symbols when they do not know how to use them, donors must clearly lay out the conditions for use, and monitor progress systematically.

Obsolescence of software and hardware. This is a common problem, especially in developing countries. The ideal solution is again through a remote support agreement with the supplier that calls for regular upgrading of equipment and software over say, a 3-year contract. Where this is not possible, older items can be handed down the chain to the primary level where high computing performance is not as critical, since most K to 6 software can sit on fairly basic platforms. In several countries, arrangements with local technical colleges prove of mutual benefit, since the technical learners have access to a steady supply of cases in a real life situation, and the schools can expect quick turnaround and continued support. Education departments in the Asia-Pacific region seldom take advantage of excellent free software, such as Star Office, nor are they generally aware of special considerations that are available through educational licensing agreements with the major suppliers.

Unreliability of equipment. This may have been a problem for equipment purchased prior to 2001, but the technology has improved so much since that it should no longer be an issue. PCs do not require air-conditioned clean environments. The server can hold all software and delicate components, and it can be located in a protected closet. User terminals consisting of monitors, keyboards, and mice, and other devices are very robust and can withstand a very wide range of environmental conditions.

Poor technical and administrative support. This obstacle is an element of the planning process. Technical support is just as critical as up-to-date software, connectivity, and reliable appliances. Political

commitment to ICTs must include adequate budgets for support to prevent teachers from getting bogged down in administrative and technical issues.

Lack of institutional support in leadership and planning, and minimal involvement of teachers and managers in implementing required change. This barrier is very closely linked to the management of change issue discussed above. The introduction of ICTs involves institutional change that requires that everyone move ahead together, and teachers are not left unsupported. There must be a minimum threshold of basic ICT understanding as well as ownership common to all members of an organization before full-scale introduction of ICTs.

Training is not differentiated according to teachers' differing ICT skill levels. A common error is trying to maximize numbers attending a training session, rather than optimizing the number of well-trained and motivated teachers who could, in turn, help their peers. The former approach fosters a climate where some are bored while others are constantly challenged. Differentiation of learners according to their own aptitudes and prior training is essential to making effective progress. A sensible and standard three-level approach like that used in Hong Kong is an excellent methodology.

Teaching in basic skills is not followed by training focusing on integrating technology in the classroom. The learning of basic computer skills by teachers is only a first step in a continuum, and should not be seen as an end in itself. Starting with basic familiarization, a laddered approach, such as that used by Schoolnet India, can support the teacher to promising and much needed career specialization, such as course authoring, content development, and multimedia design. In turn, a strong core capability with a diversified field of expertise will provide much enhanced service to the student population.

B. Applications and Benefits of ICTs in Education

This section includes spin-off effects that impact on poverty reduction and employment prospects.

Teachers and Learners and their Environment

A comprehensive review of research findings on ICTs in education reveals that they are surprisingly unanimous in concluding that ICTs stimulate:

- Less directive and more student-centered teaching.
- Increased emphasis on individualized instruction.
- More time engaged by teachers in actually advising students who require more attention rather than trying to provide a "one size fits all" service.
- Increased interest in teaching as a profession and a practice.
- Broadening of professional sources of knowledge and training and career horizons for teachers.
- Interest in experimenting with emerging technology.
- Teacher preferences for multiple technology utilization.
- Increased administrator and teacher productivity.
- Improved planning and collaboration with colleagues.
- Rethinking and revision of curriculum and instructional strategies.
- Greater participation in school and district restructuring efforts.
- Business partnerships with schools to support technology.
- Increased education involvement with community agencies.
- Enhanced and more frequent teacher and administrator communication with parents.
- Enhanced and more knowledgeable involvement by parents and home tutors in supporting the learner.

Results

The keys to raising student achievement are to provide students with a solid foundation of basic skills and to motivate them to learn. Technology can help accomplish this goal. It engages students and

fires their imaginations. It helps teachers stimulate young minds in ways that make a profound and lasting difference. A number of results have been proven attributable to the introduction of ICTs in education:

- Students were found to score significantly higher in standardized tests.
- Students studying language arts in a multimedia environment gain more auditory, language, decoding-in-context, and story-composition skills than students who do not use computers.
- High school students were found to retain math skills longer after using commercially available mathematics software than did students in a control group receiving traditional classroom instruction.
- A study of elementary-aged students learning math found that students who used multimedia computer software showed less math anxiety and more frequently perceived the subject as relevant to everyday life than students in a control group.
- Another study found that technology improves students' communication skills and the quality of their presentations and makes it easier for them to complete writing and editing assignments.
- Researchers analyzing how technology affects the study of science discovered that adding computerized lab analysis tools and simulations to high school biology curricula led to significantly better content knowledge and science process skills.
- Students who tend to refuse to do class work were found to be more motivated and eager to work since they did not perceive computers as an "authority figure."
- Students especially "at risk" were found to improve their attitude and confidence toward learning.
- Students with learning handicaps significantly improved their problem solving skills.
- The use of telecommunications leads students to improve their writing skills.
- Students showed increased mastery of vocational and work force skills.

- Computer use facilitates student collaboration on projects, and thus enhances the team work abilities that are indispensable in the work place.

Impact in Specific Areas

Numerous research studies on the impact of technology on student achievement have demonstrated these findings with remarkably similar results. A review of the literature resulting from these studies supports the following conclusions:

- Students, especially those with few advantages in life, learn basic skills—reading, writing, and arithmetic—better and faster if they have a chance to practice those skills in a self-regulated, non-intimidating, motivating, and challenging environment using technology.
- Technology engages students on a personal level, and as a result they spend more time on basic learning tasks than students who use a more traditional approach.
- Technology offers educators a way to individualize curriculum and customize it to the needs of individual students so all can achieve their potential.
- Students who have the opportunity to use technology to acquire and organize information show a higher level of comprehension and a greater likelihood of using what they learn later in their lives.
- By giving students access to a broader range of resources and technologies, students can use a variety of communication media to express their ideas more clearly and powerfully.
- Technology can decrease absenteeism, lower dropout rates, and motivate more students to continue on to college.
- Students who regularly use technology take more pride in their work, have greater confidence in their abilities, and develop higher levels of self-esteem.

C. Configuration of Hardware, Software, Policy, and Training for Classroom Operations

From lessons learned over the past ten years, we know that there are a few basic ways that computers can be distributed and configured to meet educational goals; we have also learned what does not work. PCs can be provided to individual classrooms, installed in central computer labs and used by students in rotation, or placed in libraries, with some in teachers' planning rooms. Each of these options, and their combinations, has associated benefits and costs that need to be carefully considered.

Computers in Classrooms

According to a study by the Milken Family Foundation, computers inside classrooms are more effective than centralized computer labs in producing basic skill gains in students and in promoting the confidence and technological competence of teachers. Teachers who had computers in the classroom reported higher skill levels in delivering instruction, planning lessons, managing paperwork, and word processing, and more time using computers for reading, math, and writing instruction than teachers whose access was limited to computer laboratories.

Locating PCs in classrooms has significant benefits. The PCs are closer to the users, and teachers and students may interact better in a classroom environment. But not all schools and classrooms can accommodate computers in sufficient numbers. Providing only one or a few computers in all classrooms of a school will likely have little or no impact on learning since it will be difficult for teachers to make computer use an integral part of their teaching, especially if the ratio drops to less than one computer for each five learners. Theft and vandalism need to be considered when placing PCs in classrooms. Also the maintenance of software is important. Software is easy to steal. Implementers must seriously consider the use of the Deep Freeze[156] or Radix products to ensure daily integrity of the PCs.

[156] Product of Faronics Inc.

Alternative to Computers in Classroom Strategy

Computers On Wheels (COWs), like HP's Rover product, are carts that hold a set of computers (10 to 20), usually laptops, often a printer, with the possibility to connect to a school network via a single network connection. COWs can be wheeled into a classroom when the teacher wants to use computers for a specific activity. COWs can be beneficial because it makes it possible to provide teachers access to computers in their classroom without having to significantly remodel the room, provide special furniture, or reserve space for dedicated computers. Using battery-powered laptops makes it possible to avoid the need to provide special electrical power. COWs allow schools to optimize the use of expensive equipment by enabling any teacher to request a cart of computers. Since software only needs to be purchased for the computers on the carts and not for dozens of computers in each classroom, the cost for software can also be much less with COWs than with conventional classroom computer installations. However, the initial cost of COWs with laptops and wireless networking capabilities is higher per computer than conventional stationary computers. COWs can be seen as "communal" property and therefore it can be more costly to maintain them—especially when using laptops—than with stationary systems. There is also a greater risk of equipment damage from accidents, hard use, or dropping with COWs using laptops than with stationary equipment.

As an example, Hewlett Packard's COW holds and operates as many as 30 laptop computers in a classroom. It is built on wheels, and can be rolled into a classroom ready for use. The big benefit is that the power system allows for all the laptops to be charged at the same time without the school having to change its electrical system. All these laptops are then enabled with cached content provided by the SchoolWeb[157] system. They may be wireless or wired. But the former is recommended.

[157] http://www.advancedinteractive.com/SchoolWeb/CANARIE.html.

Computer Rooms or Labs

Establishing one or more computer rooms or labs is a popular way to provide a more distributed and equitable access to computers for the greatest number of students at the lowest possible cost. Like science labs, the computer labs enable schools to concentrate expensive resources in a common space that can be used for student educational and extramural activities, teacher professional development events, and community groups. When using computer labs, it is important to arrange computers along the walls of the room rather than in rows so that teachers can view all the students' work from a common point and move quickly and easily from student to student, providing feedback and support. It can also make it easier and less costly to provide electricity and network access to the computers.

Among the benefits of having Computer Labs are:

- Quality and clean electricity, network cabling and servers, effective security, good lighting, and furniture can be installed in one or two rooms in a school rather than in many different rooms. With today's technology there is no need to have climate-controlled rooms anymore. The fans installed in PCs today are quite adequate. Equipment and software costs can be less for computer labs used by all classes than by classroom-based systems;
- Computer labs can make it easier to encourage collaborative projects among groups of teachers and students.

However, computer labs can quickly become oversubscribed and competition for their use may make it difficult for teachers to engage their students in longer-term ongoing projects and activities. Furthermore, scheduling conflicts can frustrate teachers and inhibit use of computer labs. Additionally, users, as with COWs, can see computer labs as a communal resource and thus feel a reduced sense of responsibility, thus making maintenance more difficult.

Learning Networks for Schools

Today the majority of schools in Asia do not have learning networks. In fact, many schools do not have enough computers to justify a network. And even if they had them it would not be surprising to find that many of them are not working because "they crashed," and no one was available or qualified to fix them. Schools in Asia cannot afford technical staff. In fact, those that do lose them quickly to industry thanks to better conditions and income.

Despite this situation, schools are progressively getting more PCs and enterprising teachers are using them as a resource in teaching. In more progressive locations such as Singapore, Malaysia, Taipei,China, and Hong Kong, China, it is probable that most schools have a number of PCs used for teaching or for research purposes. Programs such as "Computers For Schools," where the business community donate their older PCs to schools, have helped greatly in PC placement in schools and in preparing students for the digital world.

Nevertheless, teaching using PCs in schools in Asia is a rarity. Why? Many schools do not have know-how or budgets for such forms of teaching because ministries of education have not promoted it because of a lack of vision and skill at the ministerial level. Most educators, however, know the immense benefits of being able to teach a subject using multimedia resources to illustrate a point. Imagine everyone is class being able to see, in color, how a four-stroke combustion engine works by going to a web page put up by How Stuff Works (footnote 163), instead of trying to understand the concept by reading a book with passive illustrations. Lack of bandwidth, however, may not allow this to be done on a classroom basis. If 40 students go to http://Howstuffworks.com at the same time, the server may not be able to handle the simultaneous hits. Even if it were able to, the time taken to deliver the site to 40 PCs in the same classroom in a distant and remote location would be a problem. Fortunately, this bandwidth problem has affordable solutions developed in the Linux platform. Today, it is possible for a school that is equipped with a 56K line to have high-speed delivery of learning content to a classroom.

Canarie's[158] SchoolWeb is a consolidated server technology that enables schools with many computers to access high-speed Internet at a very affordable cost. The developers of this technology, Advanced Interactive, promote the service with the notion "*High-speed Internet for 2.00 per student per month.*".The caveat is that the school must sign up for 5 years, and have at least 1,000 students—although more modest pilot projects can be implemented in developing countries. As part of the agreement, a CampusAxxess, or SchoolWeb firewalled Linux system, will be installed in the school with no license fees attached, 40 PCs, and a network printer. The only recurring cost for the school is a monthly monitoring service charge of $250. Every student will be given an email address and a web page. All schoolwork will be automatically backed up every night. This system is a boon to remote schools. Advanced Interactive has partnered with HP to look after all the servers across the world for 36 months. Additionally, it has partnered with WorldSpace for one-way satellite connectivity that feeds the Internet service. The receiver system from WorldSpace, which is included in the price, is set at very low cost because the company's vision is better education for Africans and Asians.

National Learning Networks

UNESCO recommends that each country establish a national network that networks schools, universities, and colleges to national and international distance education facilities with databases, libraries, research labs, and computing facilities. This is a tall order for many countries, with capital and operating costs appearing prohibitive at first glance. But the results may be well worth it. In fact, throughout Asia countries are taking initiatives to set up national networks. For example, Sri Lanka has this aspiration in its education modernization plan.[159] It sees this kind of network as a tool for peace and an instrument for raising standards of living. The interactive sharing of information between users regardless of race, gender, religion, or color has enormous benefits, which will help realize the potential of human capital.

[158] See www.canarie.ca.

[159] See Sri Lanka Distance Education Modernization Project in Appendix 1.

Indonesia has launched a student computer literacy program aimed at introducing information technology in schools nationwide. Dubbed "One School One Computer Lab," one objective of the program is to establish infrastructure in the form of sufficient hardware for schools and improving telecommunications and Internet infrastructure in a number of regions.

Similarly, India has announced an ambitious $8.2 million plan to set up 139 Community Information Centres connecting villages across Indian-administered Kashmir, to connect the state's 2,681 villages, alongside call centres and other schemes to boost IT.

The Philippine government launched a $22-million Integrated Distance Learning Program in June 2003 which uses satellite, television, computers, the Internet, and solar power to target some 3,000 communities, or barangays, across the Island of Mindanao. The program is designed to address the low quality of education and facilities among indigenous peoples, and to help eradicate the roots of insurgency in the region.

South Korea, according to the BBC, is embarking on a huge project to make its national broadband network even faster. The government and telecommunication companies will spend nearly $2 billion to upgrade Korea's network. When the project ends in 2010, the top speed of South Korea's core broadband infrastructure will be 100Mbps.The network would be linked with the country's wireless networks to create a ubiquitous system that boosts e-health and education initiatives.[160] Developing countries of Asia and the Pacific do not have the economic or technological capability of South Korea. However, many could approach such a vision in small increments by building LANs in schools with classroom networks that are linked to the Internet, as outlined in the previous section.

Other Issues

a. Used Computers

With the cost curve for PCs constantly going down, it is preferable to select new equipment—with lower maintenance, improved power

[160] BBC News, Nov 20, 2003.

economy, and better robustness—over used hardware. However, where a viable local alliance can be established, used hardware may very well be worthwhile to provide access and some familiarization to PCs in schools until budgets are available to upgrade to current models.

The Canadian experience provides a valuable example. The Computers for Schools (CFS)[161] concept was first implemented by Industry Canada in 1993 with the support of the Telephone Pioneers of America—a volunteer organization of current and retired telecommunications employees who do community service across North America. Their "Connecting Canadians Initiative" is a multibillion-dollar effort to boost ICT and related applications. Included programs are Schoolnet, the Community Access Program, and Computers for Schools. To date, the latter program has refurbished and distributed to schools over 300,000 PCs donated by federal and provincial and municipal governments, the private sector, and other institutions. In addition to coordinating computer donors and recipients, CFS oversees more than 55 repair and refurbishing centers throughout Canada, where surplus computers are cleaned, refurbished and prepared for delivery. The workshops are staffed by volunteers, including current and retired telecommunications professionals and students. Of special interest is the number of unemployed youth—sometimes classified as "at risk"—who have joined the program and received valuable training leading to gainful employment.

b. Technical Support

Many projects funded by multilateral institutions and other donors for the acquisition of PCs for education do not seem to adequately address the need for hardware and software maintenance. The only backstopping provided may be a combination of the suppliers' warranty, local or school resources, and the poor teacher. Teachers should be trained in how to do some very basic PC troubleshooting, but nothing more than could be resolved easily in five minutes. Technical support is not the teacher's function.

[161] http://cfs-ope.ic.gc.ca/default.asp?lang=en&id=55.

As presented above, the CFS model could apply when new equipment is purchased, since many problems encountered in the classroom environment at the outset will not be addressed under a supplier's warranty. They are more often than not attributable to misuse, viruses, Trojans, or simple neglect. An interesting study was performed in 2003 for the UK's Becta,[163] which clearly demonstrated that CFS-like arrangements with local high schools were by far the preferred technical support solution.

c. Software and Reliability

Schools require reliable software products. It is difficult enough for them to invest in expensive software, but it is a serious problem if those products do not work properly, waste time, frustrate teachers, and do not benefit students. Microsoft, the leading designer of software, has been training its programmers to write more reliable code, and has invested in software tools that check computer code more thoroughly for errors during product development. It has developed software that culls detailed feedback on problems users are having, and uses the feedback to improve products.

Many schools, however are considering using Linux-based products simply because they are not only more reliable, but less expensive. There is a tremendous wealth of very effective and compatible software available from suppliers who are offering their product free, at very little cost, or as part of philanthropic efforts. The best-known applications are Sun's Office, Corel Office, OpenWebMail (openwebmail.org), and Open Office on the Linux platform (openoffice.org). In addition, the major systems providers such as Cisco, Hewlett Packard, Sun, Microsoft, and several others provide free applications software designed to help teachers and learners. Although some of it has a few advocacy strings attached, it is normally state-of-the-art product. Many of these companies also sponsor special educator training programs.

[162] See http://www.ictadvice.org.uk/performance/graph.php?section=4&id=136.

d. Security

Hacking, virus attacks, and spamming are common problems. The number of reported computer security incidents rose from almost nothing in 1998 to close to 120,000 in 2003.[163] The school zone is what has been called "the nightmare zone." School systems are hacked daily, and there are even hackers among students. The cost of fire walling students from these systems could be prohibitive. One less expensive way is to not allow students access to the network systems. By installing programs like Deep Freeze (footnote 192), the integrity of PCs can be maintained. If there is a compromise, the PC only need be re-booted to be returned to its original state.

D. Easy Access Reference Materials

Applications

a. Place Ware

This is a Microsoft product that enables the teacher to show a slide presentation from one end of the connection via the Internet, and use a voice connection at the same time to explain and discuss the presentation. Any additions, changes, etc done by the presenter can be seen by the viewer(s) on another connection(s). This increases productivity and understanding.

b. Microsoft Office Live Meeting

This is more of a collaborative than a presentation tool. Teacher and learners can hold on-site teaching sessions and counseling sessions. A phone and PC with an Internet connection is all that is required. It can be expensive, however, because of the cost of long distance voice calls.

[163] *The Asian Wall Street Journal*. 2003. Keep Hackers Out. 17 November.

c. Smart Library

Voted as one of the best inventions of 2003 is Amazon.Com Jeff Bezos's new search engine that enables registered users to search text inside about 120,000 books. The user is limited to no more than 20% of each book. The first few pages are free. This is a boon to teachers who may be seeking information on particular subjects.

Resources for Schools

a. WebCT

WebCT is a leading provider of e-learning systems for higher education institutions. Many universities pay great sums of dollars to leverage WebCT to expand the boundaries of teaching and learning. WebCT's e-learning systems are designed to accommodate institutions across the spectrum—whether they have just begun to implement e-learning or are already deploying e-learning enterprise-wide. Webct is able to help customers realize the full value of their e-learning investments while providing a flexible, scalable path for growth by backing up their e-learning systems with world-class customer care.

b. Silicon Chalk

Silicon Chalk is a software product and system that supports collaboration, communication, exercises, note taking, and presentation in face-to-face classes where some or all students have laptops, desktops, or tablet computers. It allows distance students to participate and creates a fully interactive recording of every learning activity for later learning, review, refinement, and asynchronous participation. It facilitates the establishment of a learning community and maintains the connectedness of that community regardless of member location. Silicon Chalk recognizes the variety of activities and contexts over which learning occurs, and presents a unified environment allowing students to move from activity to activity, context to context, and role to role seamlessly.

c. Virtual Classrooms

Virtual classroom systems are making their way into DL. They are an interactive and engaging training tool where the presenter can retain the human element of interaction. However, a robust IT infrastructure is necessary. Anything short of a steady Internet connection produces latencies and disruption. This tool is good, but may also require a heavy investment in licensed software. With virtual classrooms, however, students benefit from live human interaction without the need for expensive travel. Participants can attend class from anywhere in the world via a standard Internet connection. They can work as a group and collaborate on ideas, communicating with both presenters and each other via voice, real-time text, or private one-on-one chat. Participants can also ask questions, make comments, and use a shared "whiteboard" to illustrate a point to the group. Presenters can use anonymous survey tools to check training effectiveness in real-time. Manufacturers claim that low bandwidth Internet connections would be OK, but in practice this is not so. Students also need to have microphones and speakers; consequently, the PCs must also have sound cards.

d. e-Portfolio

An e-Portfolio is not merely a file of course projects and assignments, nor is it a scrapbook of teaching memorabilia. It is an organized, goal-driven documentation of a student's growth and achieved competence during the complex act of learning. Portfolios are part of a performance assessment process designed to enable a student to demonstrate their abilities to meet course and program objectives and standards. Such assessments require students to synthesize the knowledge, skills, and dispositions acquired in a course; reflect the real-life work of the teaching profession; revise their written work; make choices that reflect their interests, abilities, and needs; and reflect on the value of the experience in regards to professional growth and development. E-Learning experts are promoting such a tool.

It is advocated in teacher education programs, instilling the norm of reflective practice as well as introducing the requisite knowledge and skills to approach teaching in a reflective way. E-Portfolios provide an opportunity and structure for student teachers to document and

describe their teaching; articulate their professional knowledge; and reflect on what, how, and why they teach.

e. Education Management Information Systems

There is a tendency to develop an EMIS as though it has never been done before, with resulting high expense, waste of time, and user frustration. Starting with a standard platform, which can range from a simple MS Access application to a complex integrated and modular relational database such as Oracle, there are literally dozens of highly competitive software packages available either off the shelf, through specialized vendors, or from counterpart institutions in the developed world.

Internet-Based Resources

The Internet offers a wealth of rich, compelling and up-to-date multimedia content for practically any course, from kindergarten to grade 12, through tertiary, and including skills development and professional training. Much of this material is available for localization with no conditions—except in some cases, a simple intellectual property agreement. Consequently, a country that aims to develop its own proprietary material from scratch will incur substantial non-recoverable expenses and a significant lag in bringing its offerings to market. This is the unfortunate tendency of some core groups with only a basic knowledge of materials development. Whether the basic subjects be in reading, mathematics, science, or humanities, the matter to be learned is similar across nations. There will be a need for much more localization in the case of such topics as history, economics, and geography, but they should be adapted from existing material and not created from scratch if at all possible.

a. Commonwealth of Learning (COL)

COL (www.col.org) has a mandate to stimulate and foster the development and sharing of open learning/distance education knowledge, resources, and technologies for learners throughout the British Commonwealth. Responding to needs expressed by the Commonwealth's 54 member governments, it engages in both in

country and regional project work, as well as fee-for-service consulting for international agencies and national governments.

b. Asia-Pacific Development Information Programme

The APDIP (www.apdip.net) is an initiative of the United Nations Development Programme (UNDP) that aims to promote the development and application of new ICT for poverty alleviation and sustainable human development in the Asia-Pacific region. It does so through three core program areas, namely: policy development and dialogue; access; and content development and knowledge management. APDIP attains its objectives through activities that involve awareness raising and advocacy, building capacities, promoting ICT policies and dialogue, promoting equitable access to tools and technologies, knowledge sharing, and networking. Strategic public-private sector partnerships and opportunities for technical cooperation among developing countries are the key building blocks in implementing each program activity.

c. Cisco Networking Academy

Launched in 1997, the Cisco Networking Academy Program[164] has evolved from a high school network support curriculum to a worldwide educational program to advance the Internet economy. Partners in the Academy Connection and Ecosystem expand the curriculum as well as the technology and techniques in order to deliver it through continuous improvement. The Academy Connection is the virtual home of the Cisco Networking Academy Program. The program prepares tomorrow's IT workforce, helps bridge the digital divide, and allows one to experience true e-learning technology. The Academy Connection also provides access for members to the Academy community where they can effectively manage academies, classes, and users, and deliver curriculum and exams.

In Ecosystem, Cisco has partnered with leading organizations to form a global ecosystem to support e-learning. Major business partners and top companies create, deliver, and promote e-learning solutions to educational institutions worldwide through the Academy

[164] See http://cisco.netacad.net/public/index.html.

program. The Internet and education are the two great equalizers of our time. When combined into e-learning, they eliminate barriers of time, distance, and socioeconomic status, creating potential for change in people and places around the world. Cisco aims at speeding this change through e-learning.

The Internet economy has transformed both the delivery and the requirements of education in the 21st century for all ages. On the Education Issues site, information about top concerns and issues—such as education reform and education technology—is gathered and summaries, briefs, and sample Academy solutions are provided to help an organization navigate new territory.

The Global Learning Network is a network-enhanced e-learning infrastructure designed to support the Cisco Networking Academy Program. It gives students worldwide a rich, interactive environment with proficiency reporting and personalized feedback that responds to multiple learning styles.

d. Computers 4 Kids

Computers for Kids (www.c4k.org/) is a program based in Hawaii, US, that provides recycled computers to schools in Hawaii and the region. Helping Hands Hawaii makes arrangements for the distribution of these computers to schools. In this way Computers 4 Kids helps students of all ages acquire the technology and technology skills they need to succeed by providing equitable access to technology resources in homes, schools, and communities. Over 50,000 children, mostly in minority groups with socioeconomic status at and below the poverty line, have been helped. The focus is to empower children in these environments with the knowledge needed for their successful introduction into the work force. Computers can be made available to Pacific island countries and territories. There are similar programs in other states (California) and in other countries to provide recycled computers.

e. International Education and Resource Network (iEARN)

iEARN (www.iearn.org/)is a non-profit global network that enables young people to use the Internet and other new technologies to engage in collaborative educational projects that both enhance learning and make a difference in the world.

f. International Telecommunications Union (ITU)

The International Telecommunications Union's Bureau for Telecommunications Development (BTD— www.itu.int/ITU-D/) has well-established programs to facilitate connectivity and access, foster policy, regulatory, and network readiness, expand human capacity through training, formulate financing strategies, and e-enable enterprises in developing countries. The ITU's BTD services encompass e-strategies, financing, human capacity building, integrating LDCs, policy and regulation, rural development and universal access, technologies, infrastructure, and applications.

g. Pacific Center for Advanced Training and Technology (PCATT)

The PCATT (www.hcc.hawaii.edu) is based at Honolulu Community College and includes a consortium of Community Colleges in HawaiI, US, dedicated to developing and providing training in advanced technology applications in Hawaii and Pacific Rim countries. Honolulu Community College also is the center in the region for the Cisco Networking Academy Program, and has working links with a number of Academies in the region.

h. Pacific Islands Development Program (PIDP)

PIDP (pidp.ewc.hawaii.edu) is a program of the East-West Center at the University of Hawaii, US, that conducts research and training activities in the Pacific island countries. It serves as the Secretariat for the Pacific Islands Conference of Leaders. Research priorities give some emphasis to the role of culture and tradition in development as well as to expanding trade and investment in the region. The PIDP website is a major source of up-to-date information on the countries of the region.

i. Pacific Islands Network (PIN)

PIN (www.unahawaii.org) is a program of the United Nations Association of the US, Hawaii Division, to promote links between pre-university schools in Hawaii and Pacific island countries via the Internet. The program has been in operation for more than a year and a number of links have been established. As the program evolves it is

hoped to establish a regional group or mechanism that will coordinate and monitor the links, and to expand the program to also cover links related to public health.

j. Pacific Islands Telecommunications Association (PITA)

PITA (www.pita.org.fj) links more than 20 of the small island states for the purpose of improving, promoting, enhancing, facilitating and providing telecommunications services in the Pacific Basin. It has an office in Fiji Islands and meets at least twice annually. Some members of PITA are actively supporting the use of the Internet in schools—-Telecom Vanuatu, for example, provides free connection and free online time to participating schools.

k. Pacific Resources for Education and Learning (PREL)

PREL (www.prel.org/) is an independent, non-profit corporation funded by the US Department of Education that serves schools across the US and its affiliated territories from Rhode Island to Palau. PREL seeks to bridge the gap between research, theory, and practice in education, and works collaboratively with schools and school systems to provide services that range from curriculum development to assessment and evaluation.

l. Pacific Telecommunications Council (PTC)

PTC (www.ptc.org/) is an international, nongovernment, non-profit regional organization embracing members from all countries that play a role in the development of Pacific telecommunications. Its over 900 members represent industry, academics, and government and are dedicated to promoting understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere–North, Central, and South America; East, South, and Southeast Asia; Australia; New Zealand; Melanesia; Micronesia; and Polynesia. The PTC organizes a major international conference each year in Honolulu, Hawaii, US, which features a strong focus on education technology.

m. PEACE CORPS

PEACE CORPS (www.peacecorps.gov) has an active program with volunteers in the Pacific islands and elsewhere. Although all are not working on Internet related projects, most of the volunteers are very familiar with the Internet and are in a position to assist schools in their project areas to install and become familiar with computers and the Internet, and participate in training programs in the region.

n. PanPacific Education and Communication Experiment by Satellite (PEACESAT)

PEACESAT (www.peacesat.hawaii.edu) is a public service satellite telecommunications network linking the Pacific Islands. Administered by the Telecommunication Information Policy Group of the Social Science Research Institute of the University of Hawaii (UH), PEACESAT conducts surveys and research on telecommunications policy in the region and organizes related training. One goal is to improve the quality and access to telecommunications at affordable costs, with some emphasis on health and education. PEACESAT has access to the GOES-7 satellite and has satellite stations in most countries of the region, although all are not fully operational. There are T-1 connections between the PEACESAT Network Operations Center at UH and Guam and the Commonwealth of the Northern Marianas Islands. Technical staff visits the countries of the region on a regular basis and monitor the situation in each country.

PEACESAT has telecommunication connections to American Samoa, to which the main schools and research institutions are connected. From American Samoa there is a direct cable link to Samoa and the National University of Samoa, with a connection to the main hospital in Apia. Services provided are voice and video conferencing, electronic mail, and access to the Internet and the World Wide Web.

o. Rotary International

Rotary International has chapters throughout the world, including chapters in Hawaii, Samoa and Fiji Islands, all of which carry out projects to support development. For example, Rotary chapters in Hawaii and Samoa are active in providing computers to schools, and can provide useful services on a number of levels.

p. asakawa Pacific Island Nations Fund (SPINF)

SPINF (www.spf.org.jp) is a special fund of the Sasakawa Peace Foundation that has sponsored a number of telecommunications-related projects in the Pacific Islands region. These include sponsoring a series of newsletters on "Lessening the Gap of the Digital Divide in the Pacific Islands," and support for programs organized by PEACESAT.

q. Secretariat of the Pacific Community (SPC)

SPC (www.spc.int) is located in Noumea, New Caledonia, and was formerly the South Pacific Commission, which was founded in 1947. All 22 of the Pacific Island countries and territories are full members of the SPC. Its work program provides technical advice, training, and research services designed to develop the technical, professional, scientific, research, planning, and management capabilities of the Pacific Island peoples. SPC has an Information Technology and Communication Unit.

r. Schools Online

Schools Online (w.schoolsonline.org/) is a public benefit organization with the mission to help students gain access and use the communication and information resources of the Internet for learning and cross-cultural dialogue. It does this by providing appropriate technology and Internet access, developing locally-driven and sustainable Internet Learning Centers, facilitating teacher professional development, cultivating online cross-cultural projects, and sharing its knowledge and experience. Since 1996, over 5,700 under-served schools in the US and over 400 schools in 35 other countries have received the equipment and support necessary to get online.

Schools Online assesses the state of connectivity in a local environment and works with the country's telecom providers and local businesses to provide affordable lease-lines, ISDN, and wireless technologies, where possible. Students work together on collaborative projects over the Internet to solve problems affecting their lives. Teachers are trained to take steps beyond their traditional experiences in education to identify, use, and share their most effective practices to maximize Internet use.

s. United Nations Development Programme (UNDP)

UNDP (www.undp.org) is the UN's global development network. It advocates for change and connects countries to knowledge, experience, and resources to help people build a better life. It has offices in 166 countries, working with them on their own solutions to global and national development challenges. As they develop local capacity, they draw on the people of UNDP and its wide range of partners.

World leaders have pledged to achieve the MDGs, including the overarching goal of cutting poverty in half by 2015. UNDP's network links and coordinates global and national efforts to reach these Goals. Its focus is helping countries build and share solutions to the challenges of democratic governance, poverty reduction, crisis prevention and recovery, energy and the environment, information and communications technology, and HIV/AIDS. UNDP helps developing countries attract and use aid effectively. In all its activities, the protection of human rights and the empowerment of women are promoted.

t. United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO (www.unesco.org) has an office in Samoa that links and serves the Pacific Islands in its areas of competence. The staff includes a regional adviser on communications. UNESCO sponsors the Pacific Youth Forum, which brings together youth from the 14 countries to work in areas of common interest. Consideration is being given to develop Internet links with Forum members as a preliminary step in linking schools in the region. UNESCO operates the Associated Schools program linking schools throughout the world. This has a growing Internet component.

u. United Nations Information and Communication Task Force

United Nations Information and Communication Task Force is a special body established by the Secretary-General to help Member States integrate ICT into their development plans and to serve as a catalyst in bridging the Digital Divide. Pekka Tarjanne, the Secretary-General's special adviser on ICT, attended the PTC Conference in

Honolulu in January 2002 and actively participated in discussions on the applications of ICT in the region.

v. University of the South Pacific (USP)

USP (www.usp.ac.fj) has its main campus in Suva, Fiji Islands, with branches in Samoa and Vanuatu and University Centers in each of its 12 member countries. It offers undergraduate and postgraduate degree programs in the major fields of interest in the region. It is a Center of Excellence for all aspects of life in the Pacific Basin countries, with emphasis on the social and cultural needs and interests of the region. It has an extensive Distance Education program and about half of the students use the satellite communications network, USPNet. USP is in a position to play an important role in development of ICT potential in the region.

w. World Bank

The World Bank has a number of ICT-related programs, including World Links for Development (www.worldbank.org/worldlinks),that links more than 1200 schools in 40 countries. The International Finance Corporation has established the Global Information and Communication Technology Group and, in cooperation with Softbank Corp of Japan, has a program to spawn start-up Internet companies in some 100 developing countries. The Information for Development (www.infodev.org) program supports a wide range of programs, including a Conference Fellowship Fund that supports meetings on information and communication technology for development, and Regional Gateway Planning Grants to assist regional groups to develop related programs and activities.

x. World LInks

World Links (www.world-links.org/english/) is a global learning network linking thousands of students and teachers around the world via the Internet for collaborative projects and integration of technology into learning. The core "value-added" of World Links is its training program, designed to help teachers and students learn to use information and communication technologies (particularly the Internet) to improve teaching and learning. World Links is currently

active in many developing countries, including Cambodia, PRC, India, Indonesia, Lao PDR, Philippines, Sri Lanka, and Viet Nam.

y. Japan International Cooperation System (JICS)

JICS (www.jics.or.jp/jics_html-e/profile/index.html) was founded in 1989 as a non-profit foundation authorized by Japan's Ministry of Foreign Affairs. It specializes in procurement in connection with Japan's Grant Aid (including Technical Cooperation). Its activities include:studies and procurement management services for grant aid; procurement of equipment and supply of information on equipment of technical cooperation; follow-up for grant aid and technical cooperation; enlightenment and support which promote international cooperation; and support for NGO activities.

z. The Global Development Learning Network (GDLN)

GDLN (www.gdln.org/index.html) is a worldwide partnership of DL centers (GDLN Centers) and other public, private, and nongovernment organizations committed to development learning and development dialogue for lasting poverty reduction. Offering a unique combination of DL technologies and methods, GDLN facilitates timely and cost-effective knowledge sharing, consultation, coordination, and training. Through GDLN, individuals, groups, and organizations design and deliver courses, seminars, and other activities that cover the full range of development issues. GDLN Centers around the world have facilities for videoconferencing, Web-based learning, and face-to-face interaction, and also offer logistical support and facilitation services. These provide cost-effective, fast, and high-impact alternatives to traditional meetings and courses, enabling people around the world to connect with each other without having to travel. Activities do not need to be delivered in a restricted period of time because people can continue working even as they participate in events. This gives them time and flexibility to read background materials, prepare assignments related to their actual work, and interact with local peers for an enhanced learning experience.

E-Learning Conferences Worldwide

E-learning Conferences Worldwide (w.conferencealerts.com/elearning.htm) provides a list of upcoming events in internet-based education, educational technology, and related fields.

VI

ICT AND EDUCATION—POLICY, STRATEGY, AND FURTHER PROGRESS

A. ADB ICT Strategy and Education Policy

ADB ICT Strategy and Action Plan

ADB's *Toward E-Development in Asia and the Pacific: a Strategic Approach for Information and Communication Technology,* was issued in 2001. It is comprehensive and logical, following good practices developed over the years by peer organizations such as UNESCO, UNDP, and the World Bank. The incorporated Strategic Approach presents a concise background of the information revolution, the impact of ICT on development, and ICTs in the context of development in Asia and the Pacific. It also makes an excellent case for the need for an ADB strategic approach for ICTs, then recommends strategic thrusts compatible with current practices in the developed world, such as, (i) creation of an enabling environment, (ii) building of human resources, and (iii) development of ICT applications and content.

The ICT Strategy's Action Plan proposes a few carefully selected generic activities:

- Undertaking an e-readiness assessment in selected DMCs;
- Integrating ICT applications in ADB activities;
- Promoting strategic alliances and partnerships with existing

ICT initiatives at all levels in the region, and establishing principles of effective public-private partnerships; and,

- Establishing a center for learning, information, communication and knowledge for Asia and the Pacific.

The proposed initial approach is sound and appropriate. By helping DMCs assess their e-readiness, in conjunction with current and proposed ADB projects where ICTs could be profitably integrated, country work plans can be developed that will motivate government and private sector support. Further, a number of initial bankable projects could be identified to help introduce and stabilize early efforts. If an enabling environment is created, the government's major role becomes that of facilitator, with most ICT development initiatives undertaken by the private sector.

In the education sector, human capacity building takes on several dimensions. The first is too often neglected: attitudinal change. Since the benefits of training people to manage change successfully in their work environment are perhaps not immediately tangible, governments tend to ignore recommendations that emphasize the need to manage change and to develop hospitable attitudes. ADB may not place enough importance in asking the client governments to retain this element in a project. The human environment must be prepared and the support of stakeholders must be enlisted. Teachers and education system administrators can be the strongest agents of change, or they can very easily resist it. Investments that seek to implement infrastructure, computers, and specialized software without taking the necessary time to lay the human groundwork are doomed to a long and costly learning curve.

Some tangible signs of progress on a wide front might have been expected since adoption by ADB of the ICT Strategy in 2001. The previous review of ADB loans and TAs over the past 4 years reveals a few cases where the ICT Strategy has been useful in bringing much-needed leverage to projects in education, and to initiatives in other sectors. However, there are many more projects where the judicious use of IT could have brought substantial leverage. Does this mean that application of ICT Strategy is not a mandatory step in project formulation, or alternatively, that it was considered, but may not have been deemed relevant in some cases for one reason or another? It appears that the ICT Strategy is useful for those who are well informed

and aware of the potential benefits of ICT. It also appears that project officers are for the most part hesitant to consider the contributions of ICTs because of perceived local barriers that would require major corrective action in other fields, such as school infrastructure, energy, human resource capacity, administrative problems, or attitudinal issues at the national level.

Progress on the activities comprising the ICT Strategy Action Plan has also been modest. Although an excellent e-readiness assessment has been performed across various sectors such as health, education, governance, emergency communications, and e-commerce in some Pacific DMCs, there is little evidence that ADB plans to pursue this approach elsewhere.

As far as integrating ICT applications in ADB activities, it appears that beyond the normal software support applications found in an office suite—e-mail, word processing, spreadsheets, presentations, etc.—there are few other ICT applications in general use. Practical applications of immediate use to ADB clients in the education sector, such as Curriculum Development, Course Design and Writing, Educational Management Information Systems, Teacher Training Materials, Interactive Multimedia Courseware, Learning Assessment Instruments, E-Books and Journals, and Open and Distant Learning, are not seen in use. It is not easy to make effective recommendations on how best to make use of these technologies under difficult circumstances without familiarity with their performance in day-to-day situations. On the other hand, ADB's Web site is generally recognized as one of the very best among the Web sites of international financial institutions and donor agencies.

The promotion of strategic alliances and partnerships with existing ICT initiatives does not yet seem to have been implemented to an appreciable degree. There are notable exceptions, such as the Distance Education Modernization Project in Sri Lanka (see Appendix 1).

The CLICK initiative was uncertain for some time, but appeared (at the time this is being written) to be back on track for implementation. CLICK was one of the first proposals approved by the Japan Fund for Information and Communications Technologies (JFICT). JFICT was established with a grant of $10 million from the Government of Japan, and was administered by ADB. Its basic objective was to help bridge the growing digital divide in Asia and the Pacific. JFICT was launched on 31 July 2001 with a roar, but then slipped into a fairly cumbersome bureaucratic process. Imaginative proposals were left

in limbo for lengthy periods since final decisions were made outside of ADB. The Fund was designed to provide support activities to improve environments for ICT development in ADB DMCs, such as policy initiatives for the development of ICT infrastructure and human resource capacities, and to help establish CLICK.

The JFICT was originally to be replenished over a number of years. It was decided, however, to limit the fund to its original $10 million, and to end it in October 2004. It is hoped that ADB will have access to an alternative mechanism for seed funding to explore the feasibility and sustainability of innovative technologies in its DMCs, perhaps something similar to the World Bank's InfoDev.[165]

One important theme that is not yet implicit in the ICT Strategy is the desirability of coordination in the development of national ICT strategies in DMCs to ensure there is some harmonization in those strategies in the region—especially in neighboring countries that share cultures and languages. It would be helpful for ADB to monitor and support such a process because the ICT environment is evolving rapidly in DMCs.

ADB Policy on Education

Although the ICT Strategy paper was released in June 2001, the subsequent *Policy on Education* of August 2002 does not even allude to it, placing in further question the relevance of the ICT Strategy.

The *Policy on Education* does offer some very well written sections on ICT in education, but the concept is not fully integrated into the underlying theme of education itself. The benefits of contemporary technology should be woven as an integral element of the policy document. Instead, ICT seems to be acknowledged graciously, but one is not quite sure where it fits in.

Today, we are in the middle of an accelerating information revolution that, for at least 15 years now, has completely modified the way most humans get things done. Information is the motive force of the current global economy. Current and reliable information is the single most critical element of business, health, politics, the arts, economics, and education—basically, in almost every field of human

[165] See Information for Development at http://www.infodev.org/.

ADB will provide more support for the application of appropriate forms of ICT to leapfrog conventional means of providing instructional resources. ADB will support development of information technology policies and strategies for the education sector, and seek to link these to improving the efficiency and quality of education at all levels. ICT, for distance education, offers enhanced opportunities to improve quality in teacher training and higher education. Connecting educational institutions to the Internet, coupled with appropriate investment in training and equipment maintenance, should be even more important than traditional support for library development. Facilitating Internet linkages between regional and non-regional universities, for example, can expand access to higher education while improving the quality of instruction in local institutions. ICT can also be used to support regional cooperation through existing networks to facilitate exchange of education experiences, methodologies, and ideas. Experiments in many countries have also demonstrated the potential of the Internet to bring immediate change to the lives of the poor by providing them with direct access to needed information. The challenge for ADB is to systematically incorporate ICT strategies into the education sector component of country assistance programs that are suitable to the context, sustainable and affordable, and directly promote access to and quality of education.

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endeavor. Education could be interpreted as the means to convey useful information to people in a way that makes it easily understood and usable by them to improve their condition. If the digital dimension is incorporated in this interpretation, then we must add… regardless of distance, location, gender, status, language, culture, religion, and time.

It is important to bear in mind is that IT is holistic. It cannot be limited to the field or discipline where it is introduced. Doing a good job of bringing ICTs into a process will require the participation and buy-in of stakeholders in other fields who may not have been involved or directly interested in traditional education projects. Planners and decision makers in education must plan their projects on a more horizontal scale, across sectors, in close consultation with colleagues in such sectors as health, business, and finance. Most resources influenced or delivered in the education sector can become common assets to the greater benefit of all, in addition to the targeted clients.

Education leveraged with appropriate technologies, or vice versa, has not been a vertical and self-contained discipline for many years in the developed world.

ADB *Policy on Education* does recognize that:

> Innovation, of course, means more than supporting ICT. It means developing and adapting new approaches to deal with a range of issues. Often, the problem is not identifying a new approach, but adopting it and integrating it with the education system. The region abounds in examples of good practices that have been developed on a small scale—often by NGOs—but never expanded or mainstreamed. Reasons for this include higher costs, lack of trained staff, unwillingness to accept change, and lack of understanding. ADB should seek out and evaluate innovative practices, and ensure support for incorporating them in the education system, especially innovations that will improve access and quality of education for the poor.

To better illustrate such interrelationships and linkages, consider microfinance, where development vectors such as education, finance, and poverty alleviation merge. In such countries as Nepal, India, Pakistan, and Bangladesh, the strongest economic and social bond poor women may share is their belonging to a Grameen Bank-like financial community. The need to belong, to be accepted, and the desire to improve their lives is so strong that it is the group that becomes the de facto judge and arbiter of members' behavior in the community—stretching its influence far beyond the sphere of financial interests, which brought them together in the first place. In this context, the microfinance institution becomes the ideal channel to deliver knowledge to members and their children. It can bring them numeracy, modest technology to manage their finances, and information on hygiene, health, governance, and many other fields. If a community access center is brought into this fertile ground, facilitating several crosscutting development themes, the poor can feel that they are the ones influencing change.

Key considerations for Asia and Pacific countries are the linguistic, cultural and religious influences that define each country's character. Stakeholders in ADB, other donors, and those in client countries must be extremely sensitive to these issues to ensure that multimedia instruction materials preserve and enhance these national and local attributes rather than render them meaningless for the learner. Great care must be taken to ensure that languages and cultures are not relegated to home and village settings only. In almost every country of Asia and the Pacific, there are major efforts underway to convert local dialects and their alphabetical characters to a format that can be used on a keyboard and for display graphically on a monitor or in print. Obviously, investments supported by ADB should bolster these efforts and make use of it in supporting the development of indigenous learning materials.

In North America, education has often been the locomotive that justified the early investments in information technology. Schools, libraries, and universities (and their research arms) are currently some of the biggest consumers of Internet services The collective and individualized movement of massive amounts of information for education and learning has required the deployment of bigger and better data carriage pipelines and local distribution systems. Once these backbone networks are operational, such as CANARIE,[166] other users are quick to piggyback on the infrastructure and thus help enhance the viability of the investment.

A key advance in the ADB education policy is the potential involvement of the private sector, especially in the tertiary and skills development layers of the education portfolio. There may come a time for a more formal segregation of themes between public and private education, since the private sector is often seen as focusing too much on high-yield knowledge in technology and business, and neglecting the less remunerative humanities. In many countries today, the physical location of the source of knowledge, such as a campus or a classroom, is far less important than access to information and support through reliable, affordable connectivity, and results of quality and credibility. In an ideal—but not impossible—education world, the student should be able to pick from both public and private sources and assemble a bouquet of courses that will count toward a degree.

[166] Arguably, the world's highest capacity transcontinental network. See http://www.canarie.ca/.

> *A strong argument exists for governments to focus their role on creating a supportive policy environment for private sector provision, determining and assessing standards of performance, setting broad national policies, and developing an accreditation mechanism… Where demand for higher education can be met by the private sector, little justification exists for the government to compete with the private sector by providing subsidized higher education at unit costs often higher than those in private institutions.*
>
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Where a good case for business can be made, the private sector has been very quick to introduce ICTs into the classroom, or to expand its client base by reaching into the remote learning environment, commonly known as distance education. In pursuing such opportunities, however, the private sector often comes up against the barrier of poor performance of the public networks (e.g. in Sri Lanka, India, and Pakistan), or monopoly interests that discourage the introduction of private networks for the carriage of knowledge (e.g. in Fiji Islands and the Marshall Islands). In such instances, the ADB can play a significant role as facilitator and financier in helping to bring about a healthy enabling environment, as highlighted in the Bank's ICT Strategy.

ADB's *Policy on Education* and *Toward E-Development in Asia and the Pacific: a Strategic Approach for Information and Communication Technology* are mutually supportive, but they are not interdependent. In future revisions, it may prove useful to ensure much stronger linkages between these documents.

B. Recommended Measures for Expanding the Role of ICTs in ADB Education Projects

For ADB, it is not simply a matter of determining if and when to introduce ICTs into the equation, or waiting for conclusive and final proof of economic viability to emerge. The world is moving ahead relentlessly with ICTs, and it is impossible to consider coping without the Internet and computers in every facet of life. As seen in Chapter II, practically every DMC has identified key areas where the leverage and efficiency of ICTs will be most beneficial. In most cases, education is the lead target sector for improvement. With few exceptions, DMCs realize they must at least try and stay in the wake of developed countries—if not narrow the gap—for purposes of trade, governance, health, tourism, human resource development, and to protect and nurture their own culture and sovereignty. It becomes imperative that ADB give full consideration to DMCs' national ICT policies and strategies in its program planning and, as the major regional donor, support them not only with traditional funding mechanisms, but also with expertise, practical demonstrations, and guidance in areas where local officials may be most vulnerable to less than optimal sources of information.

- The education sector should be considered as part of the client country's enabling environment from a holistic perspective. Most human and material infrastructure invested for educational purposes can be utilized by other sectors of the economy, thus enhancing the viability and sustainability of the investment. Too few of the ADB projects reviewed started with an education core, then opened to services for health, government, and public services generally, and for the business sector.
- Most countries' education ministries procure software at full retail cost, or if their budgets are not adequate, they make use of pirated copies. Provision of expertise in software procurement and licensing for educational purposes should be an integral part of ADB education projects. Tremendous cost and efficiency savings are available since most major firms offer very generous discounts, and there are excellent arrangements in place for free software for education in poorer countries.

- A few less developed countries that appear to have a realistic and sustainable policy and regulatory framework in place, and have made the necessary political and budgetary commitments, such as Bhutan, present a fertile ground for successful pilot projects aimed at helping the host country and building models for replication.
- ADB education projects and other projects in each DMC should be dovetailed with that country's ICT policy and its education policy and strategy. Developments in ICT in each DMC should be monitored.
- DMCs and relevant regional organizations should be made aware of ADB's interest in supporting ICT development to ensure that representatives from ADB are invited to appropriate events. Closer linkages should be nurtured with regional stakeholders and donors who have complementary interests in ICT, such as UNESCO and the ITU.
- Familiarization sessions in ICT should be offered to ADB staff in the education sector.
- ADB should recruit senior level expertise in ICT in education, and expertise in ICTs that cuts across education, health, and governance sectors.
- ADB staff with expertise in ICTs should more often participate in project identification and formulation missions to help identify needs and opportunities, and provide information on the benefits of ICTs.
- ADB should Include in the project development process a review to verify that the ADB ICT Strategy has been applied in future education projects as appropriate.
- A process for systematically monitoring significant ICT components in projects should be established by ADB so that best practices can be developed and corrective measures taken as appropriate in a timely fashion.
- ADB should consider developing some specialized sector mechanism similar to one of those of the World Bank—e.g. InfoDev—to carve a niche out for the ADB in Asia and the Pacific.

- ADB should participate more proactively in international events that determine, disseminate, and consolidate the field of knowledge in ICTs and education, such as, (i) World Summit on the Information Society, (ii) Digital Opportunity Task Force, (iii) Pacific Telecommunications Council (PTC), (iv) International Telecommunications Union Telecom and ITU ICT in Development, (v) seminars and workgroups, (vi) Center for Office and Information Technology ICT Trade Fairs (www.cebit-asia.com/all_c.html/s), (vi) World Council for Curriculum and Instruction World Conferences, (vii) International Workshop on Wireless and Mobile Technologies in Education (www.edna.edu.au/), (vii) Society for Information Technology and Teacher Education International Conferences (www.aace.org/conf/site/), (viii) IEEE International Workshops on Wireless and Mobile Technologies in Education (lttf.ieee.org/wmte2003/), (ix) International Conferences on Education and Information Systems, Technologies and Applications, (x) Pan-Commonwealth Forums on Open Learning (www.col.org/pcf3/), and (xi) SEAMEO-UNESCO Education Congress and Expo (www.seameo-unesco.org/).
- The ADB Library should seriously consider subscribing to some or all of the major ICT sources of research findings listed below so these are available online to staff, consultants and other appropriate individuals, e.g., (i) World Telecommunication Indicators Database–ITU, (ii) Database on telecommunication operators in developing countries ITU, and (iii) 2003 Information Highways and Telecommunications in Asia–Global Information Systems Inc.

APPENDIX 1
ADB Projects Reviewed for Information and Communications Technology Components

A. Asia–Pacific Region

Regional: Development of Business Plan for a Center for Learning, Information, Communication, and Knowledge (CLICK) for Asia and the Pacific (REG 36632-01)

The project was approved on 9 December 2002 with the amount of $180,000. In the knowledge economy, a premium has been added to education and intellectual capital, facilitated through information and communication technology (ICT). Improvement in dissemination and use of information and knowledge for development through ICT, especially in Asia and the Pacific, has become one of the priorities for the Asian Development Bank (ADB) and its developing member countries (DMCs). ADB is committed to supporting ICT for development and bridge the digital divide, the gap between the "information rich" and "information poor", within and across its DMCs. ADB's internal knowledge will be supplemented by external networking and greater and more efficient use of ICT, which will enormously increase the reach of ADB, its development impact, and thus its productivity. To disseminate such knowledge and best practices and facilitate access to existing ICT-based systems and experiments for possible replication in the DMCs, a regional center for learning,

information, communication, and knowledge for Asia and the Pacific (CLICK) will be established through ADB. The Japan Fund for Information and Communication Technology (JFICT) will help establish the CLICK that will be initially housed within ADB to implement a program of producing value-added information products and services using ADB's reservoir of information and knowledge for development for dissemination to a wide audience. CLICK will also provide E-advisory services through a specialized web site or "knowledge portal", and promote the use of ICT-based distant learning (E-learning) and communication systems (networks, teleconferencing), whenever possible on cost-sharing basis, to improve institutional and human capacities of DMCs to timely access, use, and sharing of information for development.

B. East and Central Asia Countries

Mongolia: ICT for Innovating Rural Education in Mongolia MON36245-01)

This project was initially listed on 28 January 2003, and estimated at $1 million to be funded under JFICT. ICT in Mongolian education has largely been viewed in terms of Informatics classes for 8 to 10th graders in secondary schools, which comprise only 324 of 668 primary and secondary schools. Grant-funded, innovative, and highly pro-poor interventions under the IIREM Project will be important in demonstrating the impact of appropriate ICT tools on broader education processes in remote areas, while extending the benefits of ADB's Second Education Development Project, and other relevant initiatives, to reach teachers across subjects and in primary-level instruction, thus improving education for all students via better teaching. The Project will further enhance equity and sustainability by piloting novel school-community partnerships. Finally, the Project will also assess the costs and benefits of a "teacher-focused" (including head teachers) initiative, using low-cost hardware, vis-à-vis "pupil-focused" approaches.

Mongolia: Second Education Development (Loan: MON 31213-01)

The project was initially listed on 2 May 1998. Amount: Estimated at $68.5 million. The Project will improve access to, quality and sustainability of pre-school, primary, and secondary education in poorer rural and urban communities through (i) rehabilitating and constructing schools to increase capacity and, improve learning and residential environments, including developing sustainable energy systems; (ii) modernizing science education, providing learning materials, training teachers, and integrating information and communications technologies (ICT) and vocational education into secondary education; and (iii) improving education management at provincial, district, and school levels. The Project will also provide implementation support to the Ministry of Science, Technology, Education and Culture.

C. South Asia Countries

Maldives: Information Technology Development (TA: MLD 34276-01)

The Project was approved on 19 December 2000 with the amount of $150,000. The objective of the proposed TA is to prepare a project to improve efficiency, transparency, and accountability of public sector management, including provision of government services, through the use of advanced information technology. The TA will assess the technical, financial, and economic feasibility of networking government organizations, setting up Web sites for government organizations through which government information is disseminated and government services are delivered, and establishing village Internet centers and Internet kiosks to provide the public with better access to the Internet. The TA will also design a telecoms sector reform package that will include a time-bound action plan for liberalization of the telecoms/Internet services market in Maldives, and a time schedule for establishing a transparent regulatory regime in the telecoms sector. In line with ADB requirements, the TA will conduct

the initial environmental examination and the initial social assessment, including poverty impact analysis.

Maldives: Information Technology Development (Loan: MLD 34276-01), (Resulting from the above TA)

The Project was approved on 17 December 2001, with the amount of $9.5 million. The Project seeks to improve efficiency, transparency, and accountability of public sector management by networking government agencies and electronically providing information and services for the public. The Project includes: (i) networking of government agencies in Male by installation of a fiber-optic cable, and connecting 20 atolls by carrier service for government agencies to share their information, and for the public to get access to government information electronically; (ii) enabling electronic delivery of public services, including the provision of applications for national citizen identification, public health service, and registration for vessels, vehicles, and aircraft; (iii) establishment of the National Computer Center, which will centrally coordinate IT policies, standards, and practices for government work; (iv) building of Internet kiosks which will provide the public with better access to government information and services; and (v) implementation of the telecoms sector reform which will eventually enable the public to get access to the Internet at an affordable price.

Nepal: Skills for Employment Project (TA: NEP 36611-01)

The Project was approved on 4 December 2002 with the amount of $400,000. The main objective of the project preparation technical assistance (PPTA) is to assist the government in achieving its goal of poverty reduction. To do this, the TA will assist the government to: (i) improve the quality of its skills development programs through an analysis of the vocational/technical education sub-sector, encompassing policy and existing institutional structures and their mandate and performance, and a needs assessment; and (ii) based on this analysis, and in consultation with government, prepare a project feasibility report with costs, components, proposed

management structures, monitoring systems and implementation arrangements to support specific interventions that will help meet the government objectives and policies agreed upon for the sub-sector. The scope of the TA will extend to the vocational and technical education (including ICT) sub-sector. The TA will conduct an analysis of the vocational and technical education sub-sector. The analysis will take into account the existing capacity within the sub-sector; its strengths and weaknesses; policies pertaining to the sub-sector; participation of women and other disadvantaged groups; geographic dispersion; role of the private sector; and the potential of vocational and technical education to address the skills development needs of the country's youth. The analysis will also include a review of existing labor market studies, if any, and conduct skills demand surveys in areas identified for potential support. The TA will undertake extensive consultations with stakeholders through seminars and workshops. Based upon the review and analysis and consultations, the TA will make recommendations for policy revisions, if necessary, cost-effective strategies, and an implementation framework with costs. For the purpose of the PPTA, technical education includes ICT.

Sri Lanka: School Computerization (TA: SRI 35192-01)

Approved on 5 November 2002 with the amount of $500,000, the Project aims to improve the quality and efficiency of basic education to meet new labor market requirements. This will be done by improving computer literacy among teachers and students, establishing electronic libraries, and developing multimedia computer courseware to overcome the problems of many unqualified teaching staff and the lack of instructional materials. The project will target especially the poor and disadvantaged youths in rural areas (type 2 and 3 schools). The project will contribute in reducing the digital divide and in preparing for information technology-related jobs. The TA will prepare an investment project with the following outputs in mind: (i) it will establish at least 1,200 school information centers and the same number of electronic libraries; (ii) about 35% of primary and secondary students (1.5 million) will be able to use computers as a medium of instruction; (iii) about 50% of school administrators and teachers (100,000) will be able to use computers in improving the quality and efficiency of basic education; (iv) multimedia

computer courseware will be developed and distributed for all the subjects taught in primary and secondary schools to overcome low quality education; and (v) ways of recovering operation and maintenance costs should be explored to make the project sustainable. The TA will have three components: (i) a comprehensive study and survey for establishing school information centers, (ii) a master plan to develop electronic library and multimedia computer courseware, and (iii) initial capacity building of school administrators and teachers in the use of information technology in education.

Sri Lanka: Secondary Education Modernization Project (TA: SRI 33245-01)

Approved on 12 August 1999 with the amount of $250,000, the Project aims to modernize secondary education by developing an integrated curriculum, introducing communication and computer skills, and improving testing to measure academic achievement. The TA will assist the government in preparing a feasibility study to develop a consolidated secondary school system throughout the country. This will include preparing an investment proposal to (i) establish a network of grades 10 to 13 schools located throughout the country to ensure equity; (ii) revise the grade 10 to 13 curriculum; and (iii) strengthen National Educational Technology Standards to modernize O and A level examination procedures and administration, including school-based assessment of individual and group activities, computer work, laboratory exercises, and guidance.

Sri Lanka: Community Information Services for the Poor (TA: SRI 36511-01)

The Project was approved on 9 May 2003 with the amount of $800,000. The objective of the pilot project is to establish a communications network among district offices, schools, health centers, local industries, markets, and villages that will provide vital information to these stakeholders. The communications network, which will target the poor and disabled, will utilize cost-effective and feasible communication modes. Types of information to be provided are commodity and crop prices, job opportunities, education and

training opportunities, health and medical information, weather and disaster warning, public announcements, etc. It will also provide services for online access, computer training, telephone calls, sending of faxes and e-mails, etc., for a fee. The target population of the project is about 2,000 students and 5,000 residents, including 1,000 poor and disabled adults residing in the Gampaha district. The project has three components: (i) establishment of a communications network, (ii) equipping and training in the use of communications equipment; and (iii) information service. The information network will be linked with the Internet, personal computers, personal digital assistances, faxes, standard phones, wireless phones, etc.

Sri Lanka: Post Secondary Education (TA: SRI 33251-01)

Date Approved: December 19, 2000. Amount: $500,000. By combining the comparative advantage of public and private post-secondary institutes and linking post-secondary institutes to new learning technologies, the project will raise the demand for cost effective post-secondary education. The project will (i) improve the quality and relevance of Open University of Sri Lanka (OUSL) course offerings through links to public-private service institutes (PPSIs), (ii) expand access to post-secondary education by developing additional regional facilities and introducing facilities sharing with PPSIs, (iii) develop a modern ICT system capable of delivering interactive courses throughout the country by linking public and private institutes, (iv) raise the management and administration level of OUSL through cooperation and coordination with PPSIs, (v) develop OUSL's capacity for providing career guidance and job placement, and (vi) integrate fee-paying post-secondary institutes under the umbrella of OUSL.

Sri Lanka: Distance Education Modernization (SRI 33251)

Date Approved: May 2003. Amount: $60 million. New learning technologies, such as distant learning (DL), can deliver excellent academic programs to a wide audience that is currently excluded from the conventional system. There is no national delivery system for DL,

and the core skills needed to develop materials and to train teachers to operate in a learner-centered environment are still in early infancy, as are the hardware and software for Web-based learning with online tutorial support. The best approach to establish a National Distance Education Network may be to link hardware and specialized software and services to the establishment of a technically competent business enterprise. This business enterprise, labeled Distance Education Partnership Program (DEPP), can offer curriculum and training expertise to create, migrate, and upgrade existing courseware to the Web and to deliver knowledge and learner support to an extensive variety of conduits nationwide. Multimedia learning centers can be located in schools, in Internet cafes, and in many other institutions, depending on the need for access to the DL network around the country. The services should be made available to public and private institutions on a cost-shared basis to engender competition, raise academic standards, and promote linkages among institutions.

This ICT approach to distance education boosts the government's ongoing efforts to develop ICT multimedia university programs on several campuses of leading universities, where course offerings provide curriculum development, training, and marketing skills for online learning. Currently, OUSL has the basic regional infrastructure for distance education outreach, but lacks capacity, materials, and skills to introduce DL. In the context of the government's determination to favor the private sector as a key instrument in education, the DEPP partnership model enlists the private sector to manage and operate a distance education network within a framework of well-defined policies, guidelines, and jointly-agreed-upon outputs of quality and quantity. Given appropriate monitoring mechanisms, this strategy represents a practical approach to professionally develop distance education programs and learning exchanges for new and ongoing courses, including those at OUSL, other public institutions such as Sri Lanka Institute of Advanced Technical Education, and for private post-secondary institutes. In 5 years, when professional staff are readily available in Sri Lanka, and when distance education programs are up and running online for a wide range of post-secondary institutions, it may be possible to either fully privatize the DEPP, or integrate it into OUSL or some other public or private institution. Under the World Bank Tertiary Education Project, support for ICT programs at public universities will be encouraged to provide the foundation for ICT courses that will eventually lead to mixed mode

and multimedia universities. Since the need is great and continues to expand, the government will incubate several sustainable small-scale programs in different regions of the country rather than aim for one, single, large multimedia university. The very nature of a multimedia university implies connectivity that can link campuses easily.

The Project supports the government's policies by increasing access to quality programs at low cost for those excluded from conventional universities. OUSL was constituted in 1980 under the Universities Act No. 16 of 1978 and OUSL Ordinance No. 1 of 1989. OUSL enrolls about 10,000 students annually in mostly certificate, diploma, and degree programs that provide a progressive ladder of educational opportunities through non-traditional teaching methods. OUSL also addresses the need to transfer the knowledge and skills capabilities required in secondary education, teacher training, social services, agricultural extension, and continuous professional development of workers in many fields. OUSL has a wide network of 26 existing and planned campuses nationwide for students who cannot leave their jobs or families to study full-time away from home. The rationale for a public-supported OUSL is that it provides public goods, especially in the social sectors, and contributes to economic growth, human development, and poverty reduction by providing post-secondary education in remote areas. OUSL enrollment peaked in 1998 and slowly fell as the quality and relevance of the programs and facilities declined due to budget cutbacks. To reinvigorate growth, OUSL needs to upgrade existing faculties on regional campuses and to streamline administrative procedures, including student admissions and tracking. OUSL has several key advantages over the conventional education system. Its unit costs are only 20% of conventional university costs on average, and with improvements in procedures and upgrading of facilities, enrollment can double over the next 8 years along with student completion rates. With a larger budget from increased enrollment, OUSL will help increase the pool of educated labor and level of public services provided outside the capital.

Another avenue to help double access to educational opportunities is to encourage public and private schools to share common resources and activities. Government policies to build public-private partnerships include (i) public awareness campaigns to share information on career guidance and job information among students; (ii) transparent accreditation policies that lead to flexible enrollment admission, accountability for monitoring academic

standards, accreditation, and transfer across institutions; (iii) DL technologies to disseminate quality programs and information around the country; (iv) foreign and local institutional twinning arrangements; and (v) public funds for cost-sharing ventures with private institutions to increase enrollment and support the needy through scholarships. Of special interest is the government's provision of matching grants to private post-secondary institutions for ICT and multimedia services that allow private schools to migrate academic programs online. The government is willing to provide matching grants to promote institutions to cover the high costs of borrowing for ICT and multimedia equipment and services to go online. The matching grant also supports stipends for needy students to attend private schools.

Bangladesh: Teaching Quality Improvement (TQI) in Secondary Education Project (PPTA: BAN26061-01)

Amount: $600,000. Date of First Listing: 20 January 2004. The Bank has been supporting rationalizing, reform and improvement in the secondary education system in Bangladesh through two projects: Secondary Science Education Sector Project (Loan No. 699-BAN[SF]) in 1984, and Higher Secondary Education Project (Loan No. 1268-BAN[SF]) in 1993. One of the significant changes being made in the secondary education system in Bangladesh is the redefinition of its structure: 5 years (grades 6 to 10) of secondary education to 3 years of lower secondary education (grades 9 to 12). In addition to the need for substantial expansion of the lower secondary education to absorb growing numbers of primary school graduates, qualification requirements and the needs for pre- and in-service training of secondary teachers are changing rapidly. To respond to the situation, the system for secondary teacher training needs to be restructured and developed.

The overall objective of the Project is to improve the quality of teaching in secondary education in Bangladesh. The PPTA will cover grades 6 to 12 and has two components: (i) sub-sector analysis—review and analyze policies and strategies pertinent to teacher training to identify gaps in the existing policy, programs, and finance in teacher development; analyze issues related to quality management at national and regional levels; assess the need for pre-and in-service

teacher training by exploring the potential of both conventional and multimedia and DL methods; provide recommendations for government strategies for improving the quality of teaching at the secondary level. (ii) project preparation—prepare a coordinated secondary teaching education support program that will help prioritize activities in the sub-sector and thereby contribute to a more efficient resource allocation and quality improvement.

Nepal: Secondary Education Support Project (Loan: NEP 34022-01)

Approval Date: 20 September 2002. Amount: $30 million. The goal of the project is to expand quality education suitable for the needs of national development. The objectives of the project are to: (i) improve the quality of public secondary education; (ii) improve access to public secondary education, particularly for girls and students from poor and disadvantaged groups and districts; and (iii) develop the institutional capacity of central and local governments and local communities to sustain and deepen the school improvement process. The project will have the following components: (i) increased equitable access to an improved learning environment; (ii) an improved and relevant curriculum, improved assessment and accessible instructional materials; and (iii) an improved and sustainable system for the education, development, and management of teachers.

D. Mekong Countries

Thailand: Secondary Education Development Project (TA: THA 35253-01)

Date Approved: December 31, 2002. Amount: $150,000. The TA will refine the design of the Ministry of Education pilot project underway in 80 secondary schools that provides DL through a multimedia network, including science, language, and computer laboratories. The TA will draw on the previous ADB assistance and government and other donor studies to design a project that helps raise the skill standards of students employing routine access to ICT infrastructure, quality digital learning materials, and professional

instruction. Special emphasis will be given to reducing disparities between rural and urban schools so students everywhere have opportunities to study a full academic curriculum.

E. East and Central Asia Countries

Uzbekistan: Education Sector Development Project (ESDP) (LOAN: UZB 34160-02)

Approval Date: 6 December 2002. Loan Amount: $38.5 million. Improvements in the relevance and the quality of education are critical to Uzbekistan's democratization and transition to a market economy. Uzbekistan's education system must also be re-oriented in a cost-effective and sustainable manner. The ESDP will support selected policy interventions, adjustment measures, and critical investments that may otherwise be hampered by resistance to change in the education system or adversely affected by budgetary constraints.

The investment Project will support government efforts to improve the quality of basic education (with priority given to poor and remote rural areas) and to modernize sector management. It will comprise three main components with several components. 1. Strengthening sector planning and management capacities will support participatory policy formulation processes and develop national capacities to manage the education reforms. It will involve: (i) an organizational audit of the education administration, with a training needs assessment of administrative personnel; (ii) a nationwide school mapping exercise combined with a community survey; and (iii) policy studies in the areas of (a) staff development, (b) nongovernment provision of education, (c) education finance; and (iii) training of school principals and district administrators. 2. Improving and extending teacher education will principally establish a distance education (DE) capacity to conduct teacher training and retraining activities. Teacher education programs will be developed and delivered in the area of: (i) multi-grade instruction, (ii) primary school teaching, (iii) field-specific teaching methods, and (iv) select junior secondary school subjects. 3. Strengthening community involvement in schooling and improving learning conditions will comprise: (i) rehabilitation of the physical infrastructure

and provision of equipment for the most resource-poor schools of the country; (ii) assistance to communities in establishing autonomous and effective school boards; and (iii) provision of grant funds accessible to schools on a competitive basis through a School Initiatives Fund (SIF).

Uzbekistan: Education Sector Development Program (LOAN: UZB 34160-01)

Approval Date: 6 December 2002. Loan Amount $70 million. Improvements in the relevance and the quality of education are critical to Uzbekistan's democratization and transition to a market economy. Uzbekistan's education system must also be re-oriented in a cost-effective and sustainable manner. The ESDP will support selected policy interventions, adjustment measures, and critical investments that may otherwise be hampered by resistance to change in the education system or adversely affected by budgetary constraints.

The ESDP will support the implementation of Uzbekistan's medium-term education and training development plan, commonly designated as National Program for Personnel Training (NPPT), by addressing four major sector-wide challenges, namely (i) modernizing the structure, contents, and processes of education; (ii) improving sector sustainability and efficiency; (iii) reforming governance of education; and (iv) providing protection for the poor. The Policy Loan will facilitate the implementation of urgent reform measures affecting the entire sector, while the Project Loan will fund key investments aimed at improving the quality of basic education and sector management practices. The medium-term education policy framework and the associated policy actions of the ESDP collectively address the four major sector challenges. Modernizing the contents and structure of education will involve: (i) pursuing ongoing efforts to streamline and simplify the structure of education, (ii) developing modern curricula and educational quality monitoring mechanisms, and (ii) strengthening the teacher education system, in particular through the introduction of DL. Sustainability and efficiency of the education sector will be enhanced by: (i) redeploying and retraining administrative staff in line with the decentralization process, (iii) reviewing the service conditions of education personnel, paying particular attention to those categories working in difficult conditions,

(iii) and rationalizing the network of schools and institutions. The governance and management systems of education should be reformed with a view to (i) developing national capacities in the area of policy formulation, planning, and financial management, (ii) encouraging community participation in school management, and (iii) supporting the emergence of a nongovernment education sector. Access of the poor to quality education will be protected by (i) an improved targeting of public resources toward deprived areas, and (ii) special assistance schemes for vulnerable population groups.

F. Pacific Countries

Regional: Information and Communication Technology Assessment in the Pacific (TA No. 5990-REG)

Approved July 2001. Amount: $300,000. The main objectives of the TA are to help the Pacific DMC governments assess their ICT readiness, prepare the framework for future development in the sector, and identify bankable projects for such. Wider and increased use of ICT will contribute to a more effective and equitable economy and society. The TA will provide assistance to the Pacific DMCs in the following areas:

- Assess the ICT readiness in the Pacific. The TA will help the Pacific DMCs self-assess the gap between ICT demand and supply, and identify the most urgent actions needed to fill the gap. The self-assessment will include (i) network availability and affordability; (ii) education, human resources, and computer literacy; (iii) e-commerce and e-government practices; and (iv) political climate and regulatory framework.
- Increase awareness of the importance of ICT, its potential benefits in the Pacific DMCs, and the resources required to bridge the digital divide. Background papers on ICT readiness in terms of physical infrastructure, financial and human resources, and political climate in the individual Pacific DMCs will be prepared, discussed in the ICT readiness workshop, disseminated, and eventually published.

- Discuss the best practices and lessons learned in using ICT. The ICT-readiness workshop will provide a forum for Pacific DMC officials to share their knowledge and experience. Case studies on what has and has not been achieved will be presented, discussed, and disseminated. The workshop will also assist in identifying and creating Pacific DMC champions for ICT development.
- Make the stakeholders aware of the other players and define ADB's role to maximize ICT benefits. With ADB's role in the Pacific and the possible partner in ICT development defined, the TA will seek the active and coordinated involvement of all stakeholders—governments, private sector, local communities, nongovernment organizations, and international organizations. The broader and more effective the partnerships between ADB and these agents, the faster the adjustment will occur.
- Assist the Pacific DMCs in preparing a practical and flexible ICT national policy and strategic framework to eventually be adopted by individual countries. The policy and strategy framework will be based on sustainability, social inclusion, and cooperation among the Pacific DMCs.
- Identify assistance needed to increase ICT effectively and equitability. Possible ADB assistance will include physical infrastructure, social inclusion, as well as services such as distant learning, telemedicine, and e-government.
- The focus countries of the Project will be all 12 Pacific DMCs: Cook Islands, Fiji Islands, Kiribati, and Republic of the Marshall Islands, Federated States of Micronesia, Nauru, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

Samoa: Supporting the Samoa SchoolNet and Community Access Pilot Project (AOTA: SAM 36513-02)

TA Amount $600,000. Date approved: 19 December 2003. The objective of the Project is to enhance an enabling environment for

poverty reduction in the rural communities of Samoa by improving the quality of education outcomes by strengthening teacher competence training/program through providing ICT connection to local schools and creation of community access facilities. This will assist the government in increasing social inclusion and reducing poverty in the rural areas by improving connectivity and—through it—education, governance, health, and access to the Internet.

G. Southeast Asia Countries

Indonesia: Technological & Professional Skills Development (LOAN: INO 31081-01)

Amount: $180 million. Approved on 29 November 2000. The Project will strengthen the role of higher education to contribute to the country's international competitiveness, and help achieve sustainable economic growth leading to poverty reduction on a gender, social, and geographically equitable basis. This will be achieved through: (i) strengthening the governance, management, accountability, accreditation, and evaluation capabilities of higher education; (ii) developing human resources of higher education; (iii) strengthening existing priority study programs, including curricula contents and delivery systems; (iv) upgrading existing educational infrastructure; (v) establishing new priority study programs; (vi) establishing a targeted student equity scheme to assist disadvantaged students; (vii) strengthening women study centers; (viii) retraining and retooling unemployed and underemployed graduates for gainful employment; (ix) strengthening and establishing student advisory and job placement centers; and (x) strengthening and establishing community and business service centers. In upgrading the quality and relevance of study programs, the Project will focus on developing a multimedia approach, wider application of information technology including the use of the English language, and a meaningful public-private partnership in higher education. The Project is formulated as a sector loan and will cover a 6-year time slice of the government's Long Term Higher Education Development Plan. The Project is expected to support about 75 subprojects prepared by

participating institutions on a competitive basis according to agreed guidelines and procedures.

The manufacturing industry was the principal engine of growth during Indonesia's period of rapid development when annual GDP growth averaged 7%. Recovery, and long-term, sustainable economic growth and the opportunity to achieve prosperity by the poor will require strengthening of exports dependent on high levels of skill, technology, and capital. Technological change has reduced the relative returns to unskilled labor, and countries that rely on unskilled labor and natural resource based goods are likely to face declining living standards. It is therefore imperative to raise workforce skill levels in order to raise living standards in the open, competitive global market. Accordingly, government intervention is required to create and strengthen the capability of the national education system to deliver knowledge and skill development through education and training while at the same time encouraging the development of linkages with industry to support the strengthening of capability formation through specific technology-based experience. In addition to requiring increased numbers of skilled technicians and professionals, renewed economic growth for national prosperity will also require highly skilled managers to support a strengthened business infrastructure and supporting legal framework. As skill requirements are subject to constant change, education systems must constantly upgrade skills taught consistent with emerging needs. Therefore, strong linkages with the employer community are required. Likewise, the delivery of transferable skills by the education system to graduates who can be classified as multi-skilled provides the required base for continuous up-skilling that is essential for business to remain globally competitive. Global competition requires global quality standards uniformly applied and assured throughout the system. Accordingly, the higher education system must provide equal access regionally, socially, and on a gender basis.

APPENDIX 2

Five Phases for Online Community[1]

"Online teaching is not for me; I want my students to learn," said the business teacher. But she does not understand.

A. Introduction

Online or ICT-leveraged learning is a merger of teaching and technology to attain optimum learning, with technology remaining in the background and it enables users to share experiences as a community. These virtual learning communities can be collaborative and supportive, and they can foster teamwork through trust, openness, honesty, and respect among members. As well, some healthy competitive behaviors will emerge. Eager and more knowledgeable peers become very powerful intermediaries to support the learning process, as long as the teachers and tutors know how best to develop and foster this resource. Dr. Nan Chico, of California State University's Graduate School, explains that students thrive by utilizing "a sociological framework to analyze the process of creation…and change in an online community." A student-centered community derives in five phases, resulting in a constructive and meaningful learning experience.

[1] Published on July 1, 2002 in www.techcommlearning.com by Esther Camm.

B. Phase One

Students sign in to individual accounts, whether from home or the classroom, and obtain access to the course material. Therefore, access to the course appears user-friendly, the program can resume where the learner left last time, and assistance is readily available in familiar links to internal or external resources such as the teacher and the help desk. The teacher or facilitator welcomes each student to the community via Email or Messenger. Because these introductory messages have a cordial and pleasant manner they inspire, encourage, and stimulate the student to participate—individually or as a member of a group that is local or dispersed across the continent—in the learning process. The welcome and feedback messages can be much more tailored than would be possible in a traditional classroom, thus the tutor or resource person can adapt messages to the student's attributes.

C. Phase Two

Learning with ICT support within the formal educational structure, much like in the traditional classroom, is a social experience. Thanks to communications facilities such as synchronous discussions, asynchronous threaded discussions, Emails, informal chat rooms and Web sites, group socialization is stimulated. Personal attributes that can become barriers between learners such as color, race, gender, stuttering or physical challenges are minimized. With electronic tools, the teacher guides the students through introductions and icebreakers to create a welcoming social environment. Hence, students become accustomed to a new format, establish personal identities within groups, acknowledge community rules, embark on a common history, and become aware of conflict resolution. As well, students embark on new and enriching relationships with the teacher/facilitator and peers.

D. Phase Three

The participants discover that technology provides a vast number of resources, such as Web sites and specialized bulletin boards.

Instructors, resource people, and students begin sharing learning materials as well as personal experiences and begin to engage in meaningful discussions and collaborations.

E. Phase Four

As students continue to learn independently or as members of teams whose composition and location can vary according to topic, and share learning experiences and real life experiences with the groups, the facilitator actively facilitates and supports from the sidelines. Within cohesive groups, students develop optimum and committed collaborations which foster learning, creative thinking, and problem solving. At this stage, the teacher intervenes only when necessary to answer questions or re-focus discussions.

F. Phase Five

Finally, within small groups and in the main class group, students work to accomplish personal and common goals. Students fully explore the learning possibilities and, through self-reflection, achieve the learning process. The members of the learning community share, support, and respond to peers. Ideally, all learning and social experiences are enhanced by electronic communication tools, sound education pedagogy, and engaged written group interactions.

G. Summary

Online communities foster authentic social relationships and stimulate students to seek and to apply knowledge, which is applicable in "real life." Moreover, the teamwork aspect of learning within communities is well established in the corporate world in developing countries, since no one individual can have all the information and expertise to deal with increasingly complex decisions in a timely fashion. The ICT-supported learning process has become active and relevant; it can provide rich experiences to produce engaged learners.

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