

■ UNESCO estimates that there are over 850 million illiterate persons in the world today, constituting 27 per cent of the adult population over 15 years of age in the developing countries. Published as a contribution towards the United Nations Literacy Decade (2003-2012), *New Technologies For Literacy and Adult Education* explores how new information and communications technologies (ICTs) can support the development of youth and adult literacy in a global perspective, particularly in developing countries.

■ The book analyses two interconnected approaches to using ICT to support adult literacy and adult/basic education. In the first, ICT is viewed primarily as a set of potential delivery and instructional tools to help people acquire the skills associated with traditional notions of literacy. In the second, the relationship between literacy, technology and development is treated in a more integral way, with literacy defined as a broader set of text and technological skills that include the ability to access, analyse, evaluate, communicate and use information to solve problems and create new knowledge.

■ The authors also discuss ways in which ICT developments can be relevant to industrialized and developing countries alike, and build a case for new notions of literacy and how technology influences and supports basic literacy and information skills crucial for economic and social development. Finally, they examine the implications and options for policy makers in the use – and indeed necessity – of expanded roles for new technologies in literacy development.

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NEW TECHNOLOGIES FOR LITERACY AND ADULT EDUCATION

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A GLOBAL PERSPECTIVE

Daniel A. Wagner
and Robert Kozma



Education on the move



United Nations
Educational, Scientific and
Cultural Organization

**New Technologies for Literacy and Adult Education:
A Global Perspective**

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Daniel A. Wagner and Robert Kozma

International Literacy Institute
National Center on Adult Literacy
University of Pennsylvania

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Preface

On 13 February 2003, the United Nations Literacy Decade was launched by UN Secretary-General Kofi Annan, UNESCO Director-General Koichiro Matsuura, First Lady Laura Bush, United States Secretary of Education Rod Paige, and other dignitaries. The Literacy Decade launch was a milestone, and it was at the same time a great challenge to the global community. As the former Executive Secretary for the Jomtien Conference on Education for All in 1990, which focused on a renewed vision on basic learning needs – and now working on technology applications in education – I am delighted to be asked to contribute this short Preface.

We are just now beginning to understand how educational improvement will increasingly depend on new tools that are technology-based, and the present work gives us the hope that much more can be done to help the most disadvantaged groups the world over. This book is forward looking, even provocative, in helping us see beyond the present, and to imagine a not-too-distant future in which technology will help foster literacy not only in wealthy countries, but also in countries that have high levels of poverty and illiteracy.

I am especially pleased to see that it is the University of Pennsylvania's International Literacy Institute (ILI) that has produced this book, along with its sister organization, the National Center on Adult Literacy (NCAL). It is at that highly distinguished university and its Graduate School of Education where the ILI was originally co-established nearly a decade ago by UNESCO and PENN. The ILI has gone on to train literacy specialists from more than seventy-five developing countries, and remains an important institutional asset to those of us who wish to see the UN Literacy Decade realize its promise. This book, released on the date of the United States' re-entry into UNESCO after a long hiatus, bodes well for the future of international cooperation in literacy work.

It is natural that the ILI and NCAL, with funding from the United States Department of Education's Office of Vocational and Adult Education, has produced this global review in support of the UN Literacy Decade. I thank authors Dan Wagner and Robert Kozma for their time and insight, and commend this book to those who are not only thinking ahead of the curve, but also committed to making the UN Literacy Decade a success.

Wadi D. Haddad, Ph.D.

President, Knowledge Enterprise, Inc.

Former Deputy Corporate Secretary, World Bank

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List of Abbreviations and Acronyms

CAI	Computer-Assisted Instruction
CBO	Community-Based Organization
EFA	Education for All
ICT	Information and Communications Technology
IRI	Interactive Radio Instruction
LDC	Less Developed Country
NFE	Non-Formal Education
NGO	Non-Governmental Organization
OECD	Organisation for Economic Co-operation and Development
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	US Agency for International Development
Web	World Wide Web

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Introduction

In January 2002, and in the context of the Education for All and Millennium Development Goals, the United Nations General Assembly proclaimed the years 2003–2012 to be the United Nations Literacy Decade (UN, 2002a), which was officially launched on 13 February 2003. The founding resolution (Resolution 56/116) reaffirmed the Dakar Framework for Action (UNESCO, 2000a), in which the commitment was made to achieve a 50% improvement in adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults. The International Action Plan for implementing Resolution 56/116 states that ‘literacy for all is at the heart of basic education for all and that creating literate environments and societies is essential for achieving goals of eradicating poverty, reducing child mortality, curbing population growth, achieving gender equality and ensuring sustainable development, peace, and democracy’ (UN, 2002b, p. 3). The Action Plan calls for a *renewed vision* of literacy that goes beyond the limited view of literacy that has dominated in the past.

These plans have come during a period of significant, interconnected economic, social and technological change, in which literacy and education have become increasingly important to personal, social and national development. Economists acknowledge that a profound shift has occurred in the role that knowledge and technology play in driving productivity and global economic growth toward a ‘knowledge economy’. The production, distribution and use of new knowledge and information are major contributors to increased innovation and productivity and to the creation of new, high-pay jobs. Developments in human, institutional, and technological capabilities become major sources of new knowledge and innovation. A parallel, linked consequence – sometimes called the ‘information society’ – is the broader social transformation resulting from the convergence of information

and communication technologies and their assimilation throughout society.

In spite of this broad and challenging vision of the future, UNESCO has stated that there are an estimated 887 million illiterate persons as of the year 2000, constituting 27% of the adult population in the developing countries. Of these illiterates, the majority are women, and nearly all are from the poorest sectors of each society. And, these are likely to be *underestimates* for two important reasons: First, adult literacy is defined variously as having been ‘achieved’ if and when a person in a developing country has completed primary school. Yet, research strongly suggests that literacy is often not achieved in primary school in many poor communities across the world, just as evidence in the United States shows that reading achievement may lag well behind grade level attained, especially in poor urban communities. Second, comparisons of illiteracy rates in developing and industrialized countries can be misleading, since definitions of literacy and illiteracy vary widely, and international statistical standards in developing countries are no longer seen as applicable in industrialized countries. One consequence of these changes in standards is that adult literacy has become a significant policy interest in wealthier countries like the USA, as much as in developing countries.

A primary goal of this book is to explore the ways that technology can support the development of youth and adult literacy, and non-formal education in a global perspective (with an emphasis on developing countries). There is no attempt to provide a fully comprehensive review of each sub-domain, but rather to use material from a broad array of sources and areas to support a growing picture of the relationships between literacy and technology. The book then analyses the two interconnected approaches to using Information and Communications Technology (ICT) to support adult literacy and adult/basic education. In the first approach, ICT is viewed primarily as a set of potential delivery and instructional tools that can be used to help people acquire the skills associated with traditional notions of literacy. In this approach, computer-assisted tutorials and other traditional technology-supported resources, such as radio and television, can make education more accessible and help adults improve their ability to decode and comprehend prose text, thus increasing their literacy, employability, and their continued use of literacy skills to become lifelong learners. In the second approach, the relationship

between literacy, technology and development is treated in a more integral way. With this approach, literacy is defined as a broader set of text and technological skills that include the ability to access, analyse, evaluate, communicate and use information to solve problems and create new knowledge. From this perspective, ICT is not just a means for delivering literacy skills but is an integral part of an information-literate society and knowledge economy. Individual participation in this society requires the skills needed to use technology as a means to access, disseminate and create new information and knowledge products for the benefit of the individual and society. But the use of these information resources also requires basic text literacy.

Discussion follows on ways in which ICT developments can be relevant to industrialized and developing countries alike, and the book builds a case for new notions of literacy and how technology influences and supports basic literacy and information skills crucial for economic and social development. The book concludes with implications and options for policy-makers in the use, indeed necessity, of expanded roles for new technologies in literacy development. In this book, the main focus is on literacy for the poor. While examples and data will make reference to research in both developing and industrialized countries, the main focus is on impact for developing countries most in need of action during the UN Literacy Decade. Naturally, there are substantial differences between what being ‘poor’ means and represents in different countries, and even within the poorest developing countries. For example, there are ICT development programmes that can exacerbate (i.e. widen) the digital divide, by investing in the top end (easier to reach) parts of the spectrum of the disadvantaged population. Thus, it is suggested that if the UN Literacy Decade is to succeed, it must also try to reach the unreached in each society, to reach those at the bottom end of the literacy divide, and to pay attention to how new technologies can make a special contribution. We conclude the book with five areas of investment and four policy recommendations that can guide the policies and programmes of policy-makers and donors as they consider the potential of ICT to advance literacy, adult education, and economic and social development. The areas of investment are:

Adult education and literacy. A dramatic increase in investment is needed for adult basic education and literacy. The current 20:1 fund-

ing ratio of formal schooling to non-formal literacy/adult education is simply too large a disparity, and one that will likely have a lasting negative impact. Basic literacy skills are the foundation for further information literacy and participation in the knowledge economy and information society.

Infrastructure and access to technology. The *sine qua non* of technology use is access to equipment and networking. We recommend a mixed portfolio of investments that includes various traditional technologies – such as radio and television – as well as computers and networking. New resources should build on and strategically extend current infrastructure and technological expertise, and they should be carefully designed to meet programmatic goals. Both limited resources and wise utilization argue for a phased implementation of new technologies. This carefully planned deployment of equipment and network solutions should fit into the scheduled development of other resources, such as the training of technical staff, the professional development of teachers, and the development of curriculum content. Pilot projects are often useful in identifying issues and solving problems early on.

Community technology centres. Community technology centres (CTCs) are a particularly strategic investment because these centres address both resource and programmatic needs. CTCs are often a relatively low-cost means to provide a range of community constituencies with their initial access to computer equipment, software and the internet. This single investment in a community can provide initial access to small businesses, social services and educators. CTC programmes often include two or more of the following services: training in computer operation and software use, training in networking management, basic literacy, adult education, business development and/or community or health services. As a consequence, these technology and digital resources can help staff provide both high-quality educational and community services.

Professional development for teachers and others. A mixture of traditional and new ICTs can be an important way to provide teachers with professional development services at a distance, and investments in this area can have significant payoffs. Not only can ICT provide direct instruction to teachers through online materials, network connections

can provide teachers with online communities of other teachers who can provide advice, share resources and build professional knowledge. Teachers not only need to learn how to operate computers and master common software tools, they need to learn how to integrate ICT into their curriculum. There is also a very important need to provide teachers and teacher trainers with up-to-date instructional methods that shift the role of the teacher toward that of guide and emphasize active student engagement in the use of ICT to find, organize and apply digital information to create knowledge products.

Development and aggregation of highly useful content. In multiple instances throughout this book, the paucity of cultural and linguistic digital content has been cited as a serious problem in many developing countries. A significant investment is required to provide the digital content (on the web or in other media) that would be most useful for poor people. This content could and should address important local needs related to health, nutrition, family planning, continuing education, employment, agricultural production, and so forth – information that people with new literacy skills could use to improve their lives. This information could be combined with existing content and organized within portals specifically designed to make the information easy to access and use by targeted user groups. The cost of production can be further reduced as the population becomes more information literate and begins to generate its own content that can be added to this shared resource.

The policy recommendations are:

Policy leadership. Policy leadership will be the key to any successful effort to introduce ICT into literacy and adult education, particularly if these efforts are to contribute to economic and social development. Projects and programmes offered outside of a policy context will fail in the long run. Many countries have developed ICT national plans to provide a policy context that guides new technology-based programmes and projects. These master plans articulate a vision for how ICT can contribute to education reform and improvement and tie this vision to other national priorities. The national plan also authorizes specific projects and programmes to advance this vision and provide the resources needed to implement them. If no such plan exists in a

country, we recommend that one be established as a first step toward an effective and sustained effort to use the potential of ICT to improve education. We recommend that adult education, lifelong learning, and literacy – particularly the broader definition of literacy as described herein – be an important theme in any new or revised ICT national plan.

Policy coordination. To maximize the impact of ICT investments, ICT-related policies in education must be coordinated with other reforms and changes in education. The mere introduction of technology, no matter how advanced, will not result in educational improvement or reform. The impact of ICT will be greater if its introduction is linked to a curriculum that emphasizes ICT use and knowledge creation as well as acquisition, a pedagogy that emphasizes student engagement, teacher training that integrates ICT into the curriculum, and student assessments that focus on knowledge use as well as recall of facts and procedures. It is essential that adult literacy and basic education policies be coordinated with those in primary and secondary education. The full impact of ICT use in education will be realized if educational policies and programmes are also coordinated with those in other ministries, such as telecommunications, economic development, human resource development, health, agriculture, and rural and urban development, etc. A national, inter-ministerial ICT coordinating agency or council could promote improved coherence in policy-making and programme development, as well as in the sharing of resources.

Private–public partnerships. The approach proposed here requires a significant shift in priorities and resources. This shift is particularly challenging for poor countries. The greatest investments in ICTs within less developed countries (LDCs) will come from the private sector, particularly the technology industry. To the extent that national policies can be articulated with and support such investments, they can be leveraged to add further support to the strategic development of infrastructure and adult education.

Outcome-oriented policies, programmes and evaluations. The significant investments required of the approach that we advocate require a significant return in terms of adult learners served and the number that become literate and productive workers and citizens. Policies should

provide both visions and goals, and programmes should provide both resources and a schedule of expected outcomes. Both process and outcome measures should be used to continuously monitor the progress of policies and programmes and provide information to policy-makers that can be used to revise and refine policies and programmes.

In sum, the promise of information and communications technologies to enhance the basic education, literacy and livelihood of poor people is a tremendously challenging area of development work today, in both poor and wealthy nations. To be effective in this period of globalization is more difficult than meets the eye. With a set of good principles, a reasonable level of support, and an eye toward innovation, a great deal can be achieved to employ ICTs to help the poorest of the poor – more than has ever been thought possible before. This is, we believe, one of the best reasons for putting both hope and support behind the UN Literacy Decade.

REFERENCE

[L]iteracy proficiency ... has a substantial effect on earnings, a net effect that is independent of the effects of education (OECD/Statistics Canada, 2000, p. 84).

[T]he ICT revolution can provide powerful new tools both for addressing people's basic needs and for enriching the lives of poor people and communities in unprecedented ways (G8 Digital Opportunities Task Force, 2001, p. 10).

Literacy is a human right (Kofi Annan, 2003).

Literacy and Development

Few areas of social and economic development have received as much attention, and as few proportionate resources, as adult literacy and adult education. Across the world – in both industrialized and developing countries alike – it is widely acknowledged that only about 5% of national education budgets is spent on the nearly 25% to 75% (depending on GNP) of the population in need of increased literacy skills.

For several centuries it has been variously claimed that literacy – a key (if not *the* key) product of schooling – would lead to economic growth, social stability, a democratic way of life, and other social ‘good things’. Detailed historical reviews have not been so kind to such generalizations (see several chapters in Wagner et al., 1999). General notions of national economic growth have been said to have a similar set of positive consequences for the poor. However, both universal literacy and universal economic growth have suffered from what has been called at times ‘development fatigue’ – namely that governments and international agencies have come to feel that a great deal of toil and funding have led to only limited return on investment.

Thus, as we enter the UN Literacy Decade (declared in February 2003), one might legitimately ask why we are doing this ‘again’. What has changed that leads us to believe that the goals and means for a special Decade will succeed when decades of prior effort have not. Has the rationale and purpose been clearly set out? Do we have new or better ideas? One way to begin to answer such questions is to see whether the concepts and activities related to literacy work have remained the same, or whether we have entered, to some extent, a changed era – where the needs and contexts for literacy, and our capabilities for promoting it, may have changed. We suggest here that this is precisely what has happened. Thus, in this book, it is first suggested that the need for literacy and basic skills has grown significantly, along

with the contexts in which such skills need to be deployed. We then turn to some new capabilities for literacy promotion, more specifically that of new technologies, and how they are beginning to change what can be done, and, indeed, must be done, in order to promote universal education for the twenty-first century. We draw connections between these new technologies and both the improvement of literacy and economic development.

In sum, we believe that the long-term implications for the use of new technologies are profound both for the delivery of literacy education and for a new vision of what it means to be literate in a world fundamentally transformed by technology. The greatest challenge is for developing countries and their donors. The prospect exists that technological developments could offer new tools to help meet the goals of education improvement, poverty reduction, gender equity, and improved child and maternal health. Or they could create new disparities between rich countries and poor. However, it is the contention of this book that a UN Decade that does not foreground technology will be reduced to repeating the benevolent efforts of the past – efforts that have meant relatively little for poor people in both wealthy and poor countries alike.

1.1. PREVIOUS INTERNATIONAL LITERACY EFFORTS

While numerous efforts have been undertaken in both research and practice in the last half-century (Arnové and Graff, 1988), it comes as no surprise that the fundamental problems, and the global statistics, on literacy have changed only moderately, whether in industrialized or developing countries. Nonetheless, due in large part to increasingly competitive and knowledge-based economies across the world, most governments and international/bilateral agencies have expressed increased concern about illiteracy and low literacy. Resource allocations, however, have remained a disproportionately small fraction of what is contributed to formal schooling. And, as will be discussed below, even substantial progress in primary school attendance has driven quality downward in many poor countries, thereby giving an erroneous policy impression that literacy problems have been ‘solved’ by primary school attendance (see Box 1).

The 1990 UN World Conference on Education for All (EFA) in Jomtien, Thailand, included adult literacy as one of its six major

Box 1

Assessing basic learning skills in Bangladesh: schooling does not guarantee literacy

Rates of illiteracy in Bangladesh have been consistently high, some 62% overall and 74% of the female population; Bangladesh remains the nation with the fourth-highest number of illiterates in the world. To assess literacy levels in Bangladesh, researchers needed to develop instruments to measure whether or not a person had achieved the essential basic learning skills considered necessary for him or her to function at a minimum level of competence in Bangladeshi society. These basic skills could be described as the minimum level required for self-sustained development. A test of basic learning skills was developed – for reading, writing, and oral and written mathematics – for an assessment of a national sample of over 5,000 individuals age 11 years and older living in rural areas. The highest level in each subject area was judged by a panel to be the *minimum* required to, for example, allow people to function in the marketplace, read passages of simple text independently and write very brief messages. Satisfactory internal consistency measures of reliability were obtained for the items on each subject level. In addition, data indicated substantial agreement between the objective ratings and self-assessments. A total of 29% of the tested sample indicated that they could read, and 24% that they could write a letter. However, almost 30% of the sample failed to master any of the levels the four subject areas tested. While evidence showed that basic learning skills and formal schooling were related, 36% had dropped out by the end of Grade 3, at which point the majority had not mastered the basic skills in any of the four subjects tested. Indeed, *those who had completed only three years of primary school showed levels of basic skills that were only marginally better than those who had never attended school at all.* (Adapted from Greaney et al. [1999].)

worldwide goals. Specifically, a number of national educational goals related to youth and adult education were agreed upon, including: (1) to reduce the number of adult illiterates to half of the 1990 level by the year 2000, while reducing the male–female disparity; and (2) to improve learning achievement to an agreed percentage of an appropriate age cohort (which might vary from country to country). As part of the Jomtien EFA goals, a new approach to learning was emphasized, one that focused on measurable learning achievement (rather than mere class attendance or participation). These challenges, then, have formed the basis for some renewed interest in literacy and adult education over the past decade, as evidenced for example in the national and international literacy assessment surveys mentioned below.

Even before Jomtien, concern about illiteracy had been a focus of human development activity in many parts of the world. As part of the creation of UNESCO after the Second World War, literacy was chosen as a key part of its mandate, and one that has been adopted by nearly all the international and bilateral agencies over the decades

that followed. Focused international conferences on literacy also show its importance prior to Jomtien, such as Persepolis (1976) and Udaipur (1982); and following Jomtien, the Mid-Decade EFA Review (Amman, 1996), World Conference on Literacy (Philadelphia, 1996), the International Conference on Adult Education (CONFINTEA V, Hamburg, 1997), and the 2000 Dakar Forum on EFA.

1.2. THE UN LITERACY DECADE CHALLENGE

In the context of the Education for All and the Millennium Development Goals, the United Nations General Assembly proclaimed the years 2003–2012 to be the United Nations Literacy Decade (UN, 2002a), which was officially launched on 13 February 2003. The founding resolution (Resolution 56/116) reaffirmed the Dakar Framework for Action (UNESCO, 2000a) in which the commitment was made to achieve a 50% improvement in adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults. The International Action Plan for implementing Resolution 56/116 states that ‘literacy for all is at the heart of basic education for all and that creating literate environments and societies is essential for achieving goals of eradicating poverty, reducing child mortality, curbing population growth, achieving gender equality and ensuring sustainable development, peace, and democracy’ (UN, 2002b, p. 3). The Action Plan calls for a *renewed vision* of literacy that goes beyond the limited view of literacy that has dominated in the past. The Plan elaborates: ‘... it has become necessary for all people to learn new literacies and develop the ability to locate, evaluate and effectively use information in multiple manners’ (p. 4).

These proposals and plans have come during a period of significant, interconnected economic, social and technological changes in which literacy and education have become even more important to personal, social and national development. Economists acknowledge that a profound shift has occurred in the role that knowledge and technology play in driving productivity and global economic growth (Stiglitz, 1999), a phenomenon referred to as the ‘knowledge economy’ (OECD, 1996). From this perspective, knowledge is both the engine and the product of economic growth (OECD, 1999). The production, distribution and use of new knowledge and information are major contributors to increased innovation and productivity and

to the creation of new, high-pay jobs. Developments in human, institutional, and technological capabilities are, in turn, major sources of new knowledge and innovation.

A parallel, linked consequence – sometimes referred to as the ‘information society’ (European Commission, 2000) – is the broader social transformation resulting from the convergence of computers and communication technologies and their assimilation throughout society. As information and communication technologies (ICTs) – ranging now from laptops wirelessly connected to the internet, to cellphone web browsers, personal digital assistants, and low-cost video cameras – become more accessible and embedded in society, they offer the potential to make education and health care more widely available, foster cultural creativity and productivity, increase democratic participation and the responsiveness of governmental agencies, and enhance the social integration of individuals and groups with different abilities and of different cultural backgrounds.

These economic, social, and technological transformations have significant implications for the skills needed by both *employees* of the knowledge economy and *citizens* of the information society (21st Century Partnership, 2003). In the knowledge economy there is an increased proportion of the labour force engaged in handling and producing and using information, rather than producing more tangible economic goods (OECD, 1996, 2001a). Consequently, employees in the knowledge economy must be able to use ICT to search for and select relevant information, interpret and analyse data, work with distributed teams, and learn new skills as needed. Particularly prized in the knowledge economy is the ability to use information to solve problems and create new knowledge. Similarly, citizens of the information society must be able to use ICT to access information about education, health care, and government services (European Commission, 2000). Participants in the information society need the skills to be creative producers of cultural artefacts and to communicate effectively with others, particularly those of different backgrounds. These changes suggest a new model for education and training. Continued economic, social and technological developments require that employees and citizens be able to acquire new skills in response to changing circumstances, to assess their own learning needs and progress, and to learn throughout their lifetime – they must become ‘lifelong learners’ (OECD, 2001a, World Bank, 2002).

While notions of ‘knowledge economy’ and ‘information society’ may characterize changes in the developed world, one might question their relevance for less developed countries where GDP, literacy rates, and access to technology are all low. Until relatively recently, developing countries have relied primarily on cheap, unskilled labour to compete in the global market. While this may be a viable short-term strategy, the United Nations Industrial Development Organization (UNIDO, 2002) encourages developing countries to take the ‘high road’ to development by building new institutions and infrastructure and investing in human capital to create new skills, information resources, and capabilities. A continuation of the current, ‘low road’ strategy would mean that developing countries and transitioning economies risk being even further marginalized because their education and training systems are not equipping learners with the skills they need to be competitive in a global economic market increasingly influenced by the creation and exchange of information, according to a World Bank Education report (2002). This report contends that skills needed for lifelong learning not only prepare citizens for competition in the global market but improve their ability to function as members of the community and thus increase social cohesion, reduce crime, and improve income distribution.

1.3. WHY TECHNOLOGY?

The United Nations Development Programme (UNDP, 2001) presents a model that illustrates the relationship between technology, skill development, and economic development. According to this model, a country’s ICT investments can directly enhance the capabilities of its citizens. Increased skill capacity can, in turn, support the further development and increase the productive use of the technological infrastructure. The growing sophistication of the skill base and the technological infrastructure can lead to innovation and the creation of new knowledge and new industries. New knowledge and innovation support the growth of the economy, which in turn provides resources needed to further develop the human, economic, and technological infrastructure and the welfare of society.

Personal participation in this technology–knowledge–economic development cycle begins with literacy. The connection between literacy, technology, and global progress (with an emphasis on develop-

ing countries) is the subject of the present work. The book takes two interconnected approaches to examining this relationship. First, ICT is viewed primarily as a set of potential delivery and instructional tools that can be used to help people acquire the skills associated with traditional notions of literacy. In this approach, computer-assisted tutorials and other technology-supported resources can make education more accessible and help adults improve their ability to decode and comprehend prose text, thus increasing their literacy, employability, and their continued use of literacy skills to become lifelong learners. The policy implications of this approach are relatively straightforward: Are the expenses associated with providing the hardware, software and delivery infrastructure for literacy learning less than those required to provide this training by some other means? Or if not less expensive, are technology-based means more effective than traditional means and sufficiently so to justify the added costs?

In the second approach, the relationship between literacy, technology, and development is treated in a more integral way – one that suggests a very different set of policy implications. With this approach, literacy is defined as a broader set of text and technological skills that include not only the decoding and comprehension of prose but the ability to access, analyse, evaluate, communicate and use information to solve problems and create new knowledge (Educational Testing Service [ETS], 2002; International Society for Technology in Education [ISTE], 1998; OECD/Statistics Canada, 2000; Quellmalz and Kozma, 2003). From this perspective, ICT is not just a means for delivering literacy skills but is an integral part of an information-literate society and knowledge economy. Individual participation in this society not only involves text literacy skills but also necessitates skills that use technology as a means to access, disseminate and create new information and knowledge products for the benefit of the individual and society.

From a policy perspective, the costs and uses of ICT are, therefore, considered in a broader educational, social and economic context. The rationale for ICT investment is not only justified in terms of providing a more efficient or effective means to deliver literacy training. The investment is also justified in terms of creating an environment that sustains literacy and development by providing a wide range of productive tools and information resources that literate people can use to promote their own personal improvement and the social and economic

development of the country. With this second, integrated approach, ICT investments would involve not only the development of the hardware, software and network infrastructure, but also the development of language-appropriate and culturally relevant content software, as well as online information on health, nutrition, family planning, continuing education, employment, agricultural production, and so forth. In addition, there is a great need for the tools and programmes to support the local development and distribution of such relevant content. A significant benefit is that this new ICT infrastructure would not only be used for adult literacy and basic skills learning *but also* to support elementary and secondary education, improve community service and welfare, and promote the development of businesses. The result would be a ‘high road’ spiral of continuous development and use of new knowledge to benefit the economy, society and its citizens. The policies and costs involved in such a coordinated approach are undoubtedly higher than those of the first approach alone – but the potential impact would be much greater.

1.4. GOALS AND STRUCTURE OF THIS BOOK

The goals of this book are to present policy-makers, researchers, practitioners and donors with a set of possible visions dealing with the ways technology can support the development of youth and adult literacy and non-formal education in a global perspective (with an emphasis on developing countries). The book begins with a description of the status, trends and problems related to adult literacy and the issues related to the application of technology to address these problems. The book then analyses the two approaches to using ICT to support adult literacy and basic education. Discussion follows on ways in which ICT developments can be relevant to industrialized and developing countries alike, and the book builds a case for new notions of literacy and how technology influences and supports the basic literacy and information skills so crucial for economic and social development. The book concludes with implications and options for policy-makers in the use, indeed necessity, of expanded roles for new ICTs in literacy development.

Status and Trends

Many countries have been actively striving to meet Jomtien's major goal of meeting the basic learning needs for all children, youth and adults, as well as the concomitant necessity for an adequate methodology for understanding whether such goals are being met. Current national and international capacities remain limited, however, for a variety of historical reasons. In the literacy domain, there is a long tradition of statistics gathering, but due to changing definitions of literacy, as well as a dearth of human capacity in the educational measurement field, the data on, and definitions of, literacy have long been open to question and debate.

2.1. CONCEPTS AND DEFINITIONS

The topic of this book is new technologies, literacy, and adult education. In our discussions we include the full range of information and communication technologies (ICTs), including traditional means of communication such as radio and television. But we focus on 'new technologies', by which we mean applications of the computer that include multimedia, artificial intelligence and networking. Multimedia is the combination of the computational power of the computer with the presentation capabilities of video and audio. Artificial intelligence (AI) uses the computational power of the computer to support and in some ways mimic human cognition. Networking includes the uses of computers that are connected via landlines or microwave to each other and the internet and world wide web.

All definitions of literacy relate in some way, at their core, to an individual's ability to understand and communicate through written text (printed or digital). Most contemporary definitions portray literacy in *relative* rather than absolute terms – gone are the days when

the ‘scourge’ of illiteracy (and illiterates) needed to be ‘eradicated’. Three of the better-known definitions of literacy are:

1. ‘A person is literate who can with understanding both read and write a short simple statement on his everyday life ... A person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his group and community...’ (UNESCO, 1978).
2. ‘Using printed and written information to function in society to achieve one’s goals and to develop one’s knowledge and potential’. (OECD/Statistics Canada, 1995).
3. ‘The ability to understand and employ printed information in daily activities, at home, at work and in the community – to achieve one’s goals, and to develop one’s knowledge and potential’. (OECD/Statistics Canada, 2000).

The 1990 EFA Conference in Jomtien broadened the discussion of literacy goals to that of basic learning needs or competencies (ILI/ UNESCO, 1999); a combination of a mastery of the three Rs with other knowledge, problem-solving and life skills. In the EFA perspective, such competencies refer to both formal school-based skills (such as ability to read prose text or to understand mathematical notations) and the ability to manage *functional* tasks, regardless of whether such competencies were developed through formal or non-formal education, or through personal experiences in diverse informal learning situations. In the present book, it is suggested that information literacy will soon be part of the expansion of the term from the traditional set of reading, writing and arithmetic skills.

Traditional definitions of literacy have been used to develop national and international assessments of literacy. International literacy data from UNESCO are widely used for making country-level cross-sectional and longitudinal comparisons. As with other aggregated country-level indicators, these data suffer reliability and validity weaknesses that stem from some chronic methodological flaws. Since the definitions of literacy are continually evolving, measures that remain the same have increasingly narrow and limited use. Constantly changing measures on the other hand, render data invalid for across-time comparisons. However, for lack of suitable alternatives, the UNESCO data are deemed sufficient for aggregate-level analyses, provided

proper acknowledgement of the limitations they present to making inferences is offered. More detailed literacy assessments for specific populations need to be undertaken separately.

There are a number of international studies that provide in-depth measures of learning achievements in reading, math, science, and so forth (the best known is the IALS; OECD/Statistics Canada, 1997, 2000). Such comparative international studies use parallel methodologies for measuring learning achievement. Alternatively, for use in programme improvement, several new low-cost, culturally sensitive assessment frameworks are being developed that combine elements of household surveys with the use of measurement tools that are attuned to local and national needs (ILI/UNESCO, 2002*a, b*; see Box 2). Data

Box 2

Low-cost methods of literacy assessment

Literacy tests have ranged traditionally from simple questions such as ‘can you read and write’, to signing one’s name, to reading a short paragraph on a life-relevant topic, to answering multiple-choice questions on a test battery. The proposed assessment scheme for reading is based on a matrix of reading skills and domains of print. This matrix can be used to define four ability levels: none, prerequisite, basic, and advanced. Reading skills, in this scheme are divided into three general categories: decoding, comprehension, applied skills. Three domains of print are described, including: (1) prose text (e.g. newspapers, pamphlets, books, stories, etc.); (2) documents (e.g. official forms, labels, advertisements, bills, receipts, etc.); and (3) decontextualized print (e.g. letters, words, phrases, and sentences). Levels of reading may be defined as follows:

None or non-reader level. This level refers to those individuals who, for all practical purposes, do not possess even the rudiments of reading skills, and cannot, for example, recognize more than a few letters of the alphabet at most.

Prerequisite level. Prerequisites to reading competency include letter recognition, decoding, and ‘sounding out’ of short texts. In some languages, such as English or Arabic, the relation of printed text to oral language is not at all simple and may require extensive knowledge of the linguistic, semantic, and grammatical structure of the language just to pronounce a printed text. Thus, decoding skill must be operationalized with respect to specific language and script contexts.

Basic level. A basic level in reading ability can be defined as skill in ‘reading to learn’ and ‘reading to do.’ The former set of skills may be seen as most related to school-based reading achievement, where the focus is on reading comprehension as a means for learning about content domains. The latter set of skills are more common to out-of-school functional literacy needs such as reading signs, following procedural directions, locating a specific item on a bus schedule, and other applied tasks.

Advanced level. Advanced skills are built on those used in basic level tasks, but are applied to more complex tasks and print domains. As noted earlier, advanced skills are equivalent to a level of skill for those who have successfully completed secondary school curriculum or its equivalent. [Adapted from ILI/UNESCO [1999]; see also Wagner [2003].]

from such low-cost (minimum data required) methods will also allow impact or evaluation research on national and local programmes that teach basic skills.

New definitions of learning competencies are prompting the development of new approaches to assessment (ETS, 2002; ISTE, 1998; OECD/Statistics Canada, 2000; Quellmalz and Kozma, 2003). These approaches often emphasize the use of technology to search for and select relevant information, interpret and analyse data, and use this information to communicate effectively with others, create new knowledge products and solve practical problems. These assessments are currently in the development and pilot-testing phase and scheduled for wider implementation later this decade. Their implementation will allow researchers and policy-makers to chart the development of these new skills, connect the impact of literacy programmes to the requirements of the knowledge economy, and adjust policies and programmes accordingly.

When referring to adult education, we take a similarly broad view. Traditionally, adult education referred to what ‘adults’ do after, or instead of, completing formal schooling. Adults are defined by the UN as individuals 15 years and older. However, in many developing countries and even in industrialized countries, we know that adolescents participate in a wide range of adult and adult education activities. Many are primary breadwinners for their families, and many have dropped out of school before primary or secondary school completion. Furthermore, programmes for adults may be organized and offered by the state, but many others are organized by non-governmental organizations (NGOs) that provide Non-Formal Education (NFE) programmes.

2.1. STATISTICAL TRENDS IN LITERACY WORLDWIDE

UNESCO (2000a) estimates there are nearly 862 million illiterates in the world aged 15 and above. Over 60% of the illiterate population are women, most of who are from Arab nations and South and West Asia (see Table 1). Compared to only a 1.4% illiteracy rate in developed nations, 27% of the total population of developing and underdeveloped countries is illiterate. Regionally, South and West Asia has the lowest literacy rate (55.3%), along with the Arab nations, which has a 60.1% literacy rate. The region with the highest adult literacy rate is

central Asia, with 99.6%. Literacy rates have increased proportionally across all regions since 1990, according to such estimates. The Arab States and sub-Saharan Africa experienced a 10% increase in adult literacy rates, 7.8% in South and West Asia, and 6.3% in East Asia and the Pacific. Overall, developing countries increased literacy rates by 6.6% between 1990 and 2000. However, in some of these regions the increases in literacy rates does not keep pace with population growth (e.g. South and West Asia) with the actual number of illiterate citizens having increased in the past decade.

The above UN data are widely discussed and utilized in policy discussions, and were indeed one basis for the declaration of the UN Decade. However, such comparisons of illiteracy rates between countries and across time should be made with some caution, since over the years

Table 1

Adult literacy (age 15 and over) by gender and region, 2000–2004¹						
	Adult literacy rates				Adult illiterates	
	%			GPI (F/M)	Total (thousands)	% female
	Total	Male	Female			
World	82	87	77	0.88	799 147	64
Developing countries	76	83	69	0.83	788 999	64
Developed countries	99	99	99	1.00	9 151	62
Countries in transition	100	100	99	1.00	998	70
Sub-Saharan Africa	62	70	54	0.77	137 000	61
Arab States	62	73	51	0.69	69 298	64
Central Asia	99	100	99	1.00	333	70
East Asia and the Pacific	91	95	88	0.92	134 978	71
South and West Asia	58	71	45	0.63	402 744	64
Latin America and the Caribbean	89	90	88	0.98	39 383	55
North America and Western Europe	99	99	99	1.00	6 946	61
Central and Eastern Europe	97	99	96	0.97	8 464	77

Note: Figures may not add to totals because of rounding.

1. 2000-2004 data are derived from the March 2004 literacy assessment by the UNESCO Institute for Statistics, which uses directly reported national figures together with UIS estimates. For countries that did not report literacy data for the 2000-2004 reference period, UIS estimates for 2002 were used. See introduction to the Statistical annex for further details on the estimation of literacy data.

Source: Statistical annex, Table 2.

Box 3

Gender trends of illiteracy in Morocco

In Morocco, a direct literacy assessment module was designed and integrated into the National Survey on Household Living Standards, sponsored by the World Bank. The main objectives of this survey were to examine in greater detail the range and variability of literacy skills and knowledge among individuals, and especially among women. The literacy survey consisted of nine sections, including self-report questions on literacy skills and behaviours, questions on basic health-care behaviours, assessment of information-location skills, mental and written numeracy assessments, and assessments of reading and writing in Arabic. A national stratified sample of 2,240 participants received the survey. The most significant finding was that Morocco has cut its illiteracy rate by one half during the past three decades, and the trend is one of continuing improvement. However, the disparities in literacy attainment between men and women (as well as between urban and rural populations) remain a major issue. Surprisingly, the gender gap in literacy among the present younger generation is even larger than that of their grandparents or even parents. Whether this is the result of selective out-migration of literate individuals from the countryside to the towns, or of insufficient educational access and quality in rural areas, is a question with profound policy implications, and requires further investigation. The findings clearly show that males have received more education than females during this time period. Results of the study suggest that part of the explanation for high levels of illiteracy in rural areas is the relative frequency of households in which both parents are illiterate, while in the urban areas men are more likely to marry a woman who has some literacy skills. The evidence indicates that completely illiterate households are far more likely to raise illiterate children, whereas maternal literacy positively affects both boys' and girls' enrolment and attainment. [Adapted from Lavy et al. [1995].]

the definitions of literacy have evolved, and the methodology of collecting data in many developing countries is severely limited (Wagner, 1990; ILI/UNESCO, 1999). Also, the standards used by UNESCO for developing countries are no longer considered appropriate for industrialized countries, which have (as noted earlier) developed their own measures for assessing literacy (see OECD/Statistics Canada, 1995; ILI/UNESCO, 1998).

2.2. LITERACY AND ITS CORRELATES

Literacy has often been seen as not only a 'good thing' in and of itself but as also having a variety of by-products of great social and economic importance, such as improved health, lowered fertility, increased income, and so forth. Thus, over the years, international agencies and national governments have tracked other factors as they are related to literacy statistics. A brief synopsis follows:

Gender. One of the most consistent findings in literacy in the world's poorest countries (especially in South Asia and in Africa) is that women have much higher illiteracy rates than men, often as much as 50% higher (see Table 1). The overall cost of such low rates of basic skills is very high, as such rates are correlated with secondary effects on child health and nutrition, HIV/AIDS, children's achievement and retention in school, and so forth. It comes as no surprise, therefore, that a key EFA goal is to address and improve the education of girls and women in poor countries, especially as intergenerational illiteracy is a major and enduring phenomenon (see Box 3).

Age. As shown in Table 2, the over-45 age group has the highest illiteracy rate in all regions (including OECD countries as well, although not shown in this table), which most likely can be attributed to the fewer years (or poorer quality) of schooling that this group received. The illiteracy rate for this older group is expected to remain high until well into the next quarter century, especially in sub-Saharan Africa, the Arab States and South Asia. A second observation is that there has been a large decrease in the past twenty years in the illiteracy rate of those in the 15–19 and 20–24 age groups, which can be attributed, conversely, to the rise in access to schooling.

Rural–urban. It has long been understood that, in developing countries especially, the poor are much less likely to receive a good education and indeed are poorer in most social and economic indicators. Literacy is no exception. Data from around the world (as exemplified by data from sub-Saharan Africa) show that illiteracy is much more prevalent in rural communities than in the urban areas (see Figure 1).

Schooling. Primary schooling and adult illiteracy are highly (and inversely) correlated, in particular since most developing countries use the rate of primary schooling as a principal proxy variable for determining who is labelled as 'literate'. In addition, it is clear that levels of out-of-school youth, in spite of increases in the rate of school enrolments in less developed countries (LDCs), continue to be high and are growing rather dramatically in Africa (see Figure 2). Overall, even though enrolments have gone up in many developing countries, the real impact on literacy achievement remains unknown for the most part, since surveys of learning achievement following schooling have rarely been undertaken.

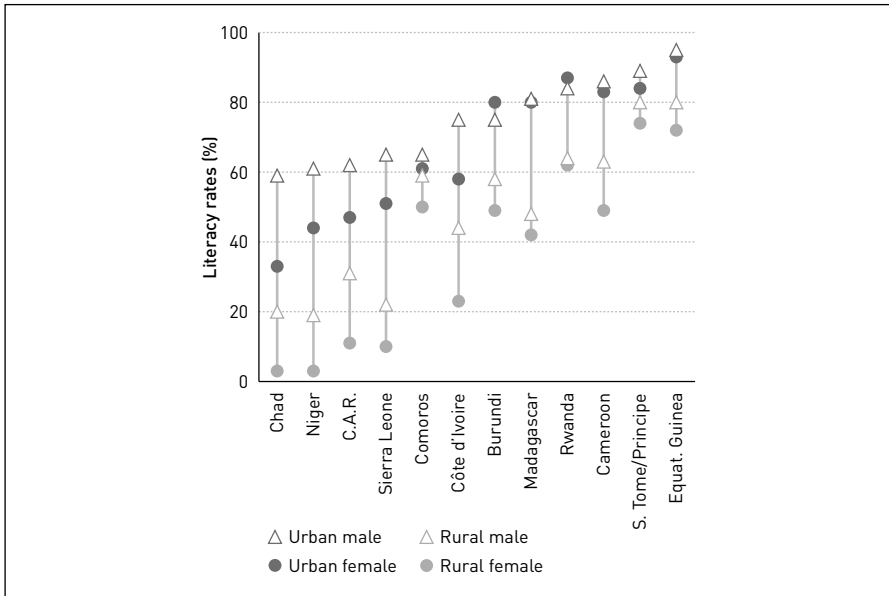
Table 2

Adult illiteracy rates (%) by age group and region												
Countries & territories	Age group	Total			Male			Female				
		1970	1990	2000*	1970	1990	2000*	1970	1990	2000*		
Developing Countries	15-19	33.9	19.1	16.1	23.7	13.9	11.8	44.5	24.7	20.6		
	20-24	39.8	21.5	17.8	28.2	13.9	11.8	44.5	24.7	20.6		
	25-44	52.9	30.9	23.2	39.3	21.6	16.4	67.2	40.6	30.2		
Sub-Saharan Africa	45+	74.4	57	45.9	62.2	42.6	32.3	86.4	71.3	59.2		
	15-19	61.8	35.9	26.4	49.9	28.5	20.9	73.5	43.3	31.9		
	20-24	68.3	40.3	31.6	56.2	31.3	25	80.3	49.2	38.1		
ArabStates	25-44	79.8	55.5	42.4	69	43.2	32.7	90.1	67.2	31.8		
	45+	92.6	82	72.5	86.6	71.6	59.9	97.8	91.5	83.7		
	15-19	54.6	27.7	20.6	39.3	19.8	14.9	70.5	36	26.6		
Latin America/Caribbean	20-24	61.8	32.9	23.7	45.1	23.3	17	78.5	43.1	30.7		
	25-44	73.9	48.5	35.2	56.5	34.4	24.7	88.8	63.3	46.2		
	45+	85.3	76.3	66.4	74.1	61.1	48.6	96.1	90.3	82.1		
EasternAsia	15-19	14.6	6.2	4.1	13.3	6.1	4.2	16	6.3	4		
	20-24	17.6	7.6	5.1	15.8	7.3	5.1	19.4	8	5		
	25-44	24.9	12.7	8.5	21.4	11.6	8	28.3	13.7	24.3		
SouthernAsia	45+	37.3	27.5	21.4	31	23.1	18.2	43.3	31.5	24.3		
	15-19	19.5	6.3	3.6	10.3	4	2.5	29.2	8.8	4.8		
	20-24	25.5	8.5	4.7	14	5.1	3.1	37.9	12.2	6.4		
SouthernAsia	25-44	43.8	16.8	9.8	27.9	9	5.5	61	25	14.2		
	45+	78	51.8	36.2	63.5	34.1	20.9	91.6	69.4	51.3		
	15-19	56.7	37.7	29.4	42.7	26.8	20.7	72	49.5	38.6		
SouthernAsia	20-24	61.1	42.3	33.4	46.7	30.4	23.7	76.2	55.3	44		
	25-44	69.2	53.1	64.7	55.4	39.7	32	83.9	67.7	57.2		
	45+	79.1	71.1	64.7	67	57	50	92.4	85.5	79.7		

*Estimated

Source : UNESCO (1990)

Figure 1. **Literacy rates for ages 15 to 24 by gender and rural or urban residence in sub-Saharan Africa, 2000**



Health. As shown in Figure 2, life expectancy and literacy are highly (and positively) correlated overall, so much so that the life expectancy in the countries with the lowest literacy rates is actually only half that of the most literate developing countries.

Figure 2. **Out-of-School Youth (6–15 Years Old)**

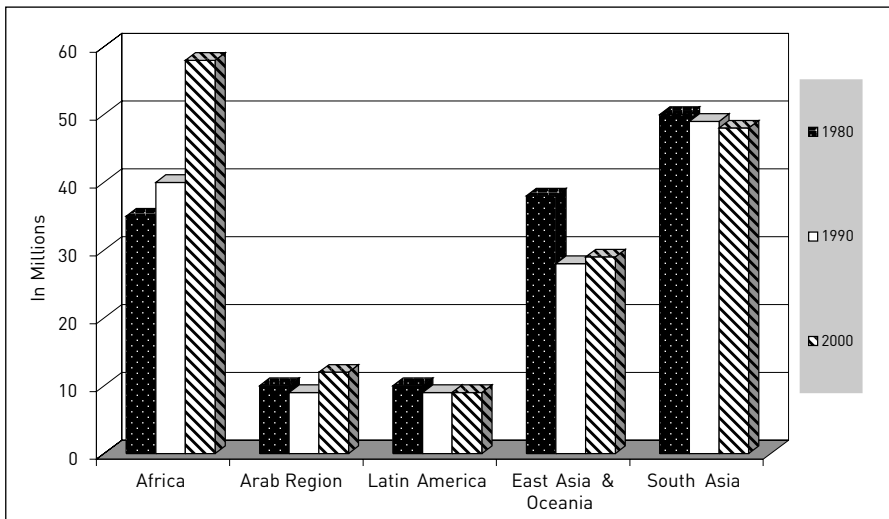
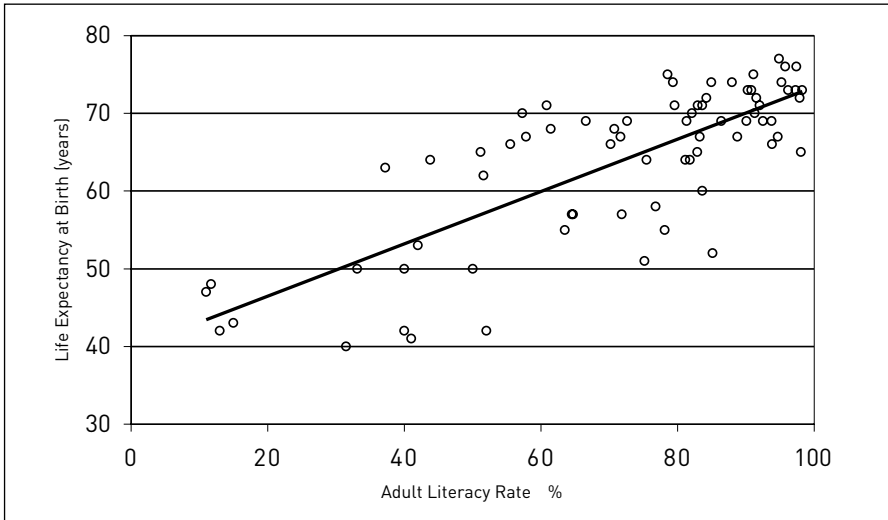


Figure 3. **Adult Literacy Rates and Life Expectancy at Birth**



Furthermore, given the common recognition of the key roles that women play in fertility planning, infant care/nutrition, and health education, it is not surprising that female illiteracy is seen as a major obstacle to health and social development (see Box 4). It should be recalled that, as with many cross-national analyses, correlations

Box 4

Women, health and literacy education in Senegal

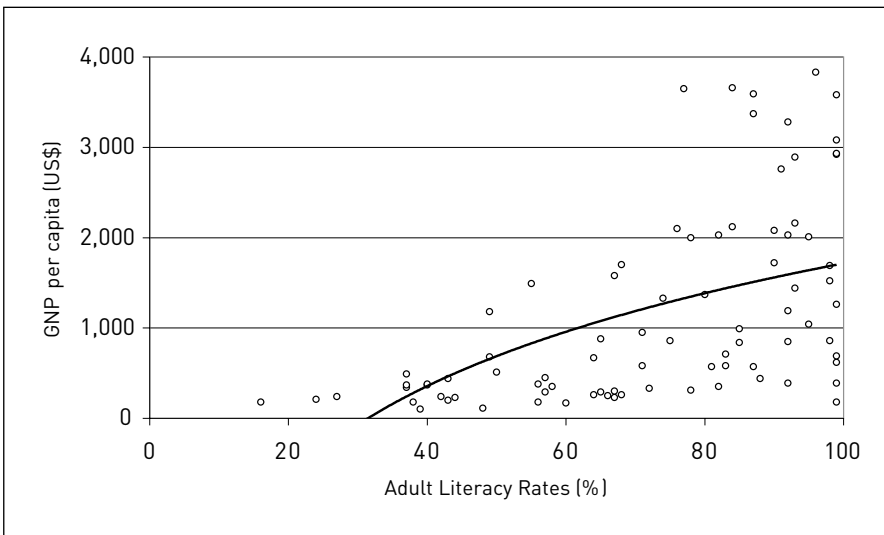
The TOSTAN Basic Education programme in Senegal was developed by a team of villagers and non-formal education specialists to improve the educational situation of villagers, particularly women. Its goals are not only to reduce illiteracy, but also to help the population achieve health and self-development through the use of adapted educational materials. TOSTAN means 'breakthrough' in Wolof, the language spoken by approximately 70% of the Senegalese people. In addition to providing rural people with the opportunity to obtain basic education in their own language, the two-year programme also integrates elements of traditional culture into the curriculum and promotes community ownership and problem-solving to improve living conditions in the villages. The programme includes a module on the use of Oral Rehydration Solution (ORS), which prevents the dehydration caused by diarrhoea, a frequent cause of death among young children in Senegal. The steps to mix and administer the ORS are taught using diverse active learning techniques, including charting and demonstrating the method, and playing a card game to help participants understand the elements for making the solution as well as the negative practices that can lead to diarrhoea and dehydration. The facilitator also engages the learners in discussion about these issues, which constitute a problem they deal with often in their everyday lives. As a result of these teaching methods, learners plan strategies based on what they have learned in the programme that will improve their communities' health conditions. (Adapted from TOSTAN [1996].)

between female literacy and health indicators are often statistically significant even though there is remarkably little evidence that shows that there is a causal relationship between these variables. Recent evidence indicates that both formal schooling and literacy may have independent effects on the health and fertility outcomes of women, but the requisite longitudinal studies have yet to be carried out (LeVine et al., 2000).

Economic. There is a widespread belief worldwide that literacy and economic well-being (at the individual and national level) go hand in hand (Windham, 1999). This is apparent in Figure 4, which shows a plot of GNP per capita against adult literacy rates in developing countries.

About two decades ago the World Bank sponsored a series of studies that explored the positive impact literacy and schooling has had on agricultural productivity (Jamison and Moock, 1984). In industrialized countries, literacy levels have been shown to be one of the strongest predictors of individual income (OECD/Statistics Canada, 1995, 1997). These trends illustrate the importance of long-term investments in literacy because of its promising impact on economic status.

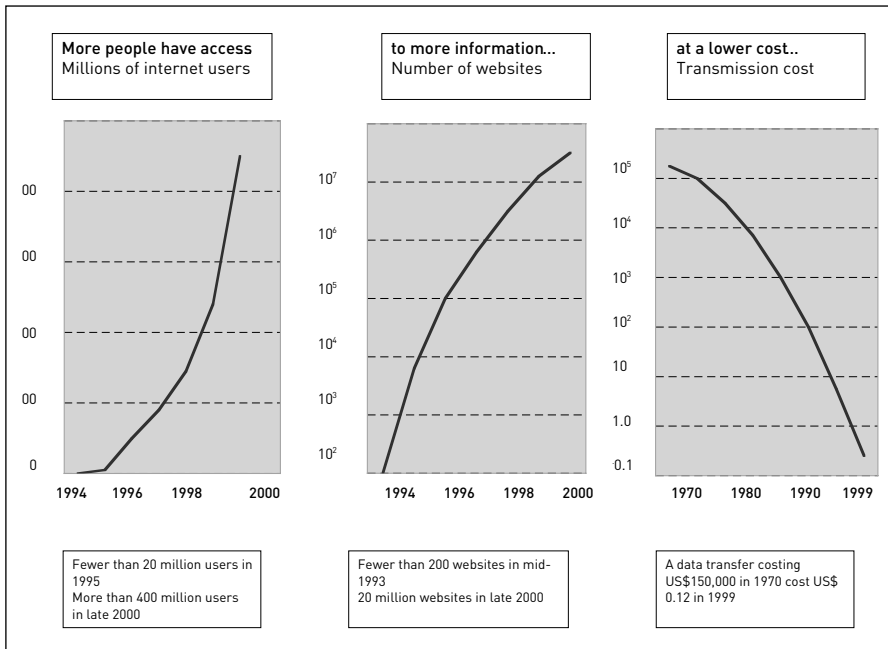
Figure 4. **Adult Literacy rates (age 15+) and GNP per capita**



2.3. TRENDS IN TECHNOLOGY DEVELOPMENT

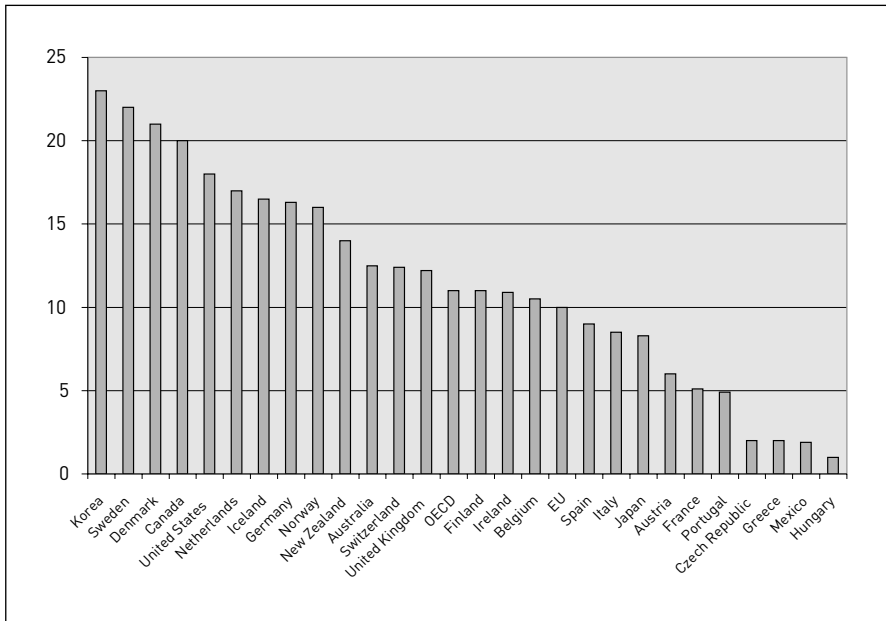
There has always been a strong relationship between the development of new technologies, major social transformations, and changing definitions of what it takes to be a literate person. These changes have not always been viewed as positive by contemporaries. In Plato's *Phaedrus*, Socrates bemoaned the introduction of written text because he felt it would reduce the skill of memory and the ability to engage in active discourse – skills that were necessary for an informed citizen of his day. He felt that written text was inferior to oral discourse because of its lack of interactivity – the reader could not engage in dialogue with it. Yet skills in decoding and comprehending written text have become the core of our conception of literacy. The invention of the printing press made the knowledge encoded in text available to a larger number of people, and it made mass literacy an important part of everyday life. The press, and the knowledge made available with it, spawned significant social transformations, such as the rise of Protestantism and the scientific revolution. Recent years have seen a tremendous growth of technological development, much of it related to the invention of the computer (see Figure 5).

Figure 5. **Changing international trends in internet use**



[Adapted from UNDP, 2001]

Figure 6. **Percentage of internet subscribers (per 100 inhabitants) in OECD countries in 2000**

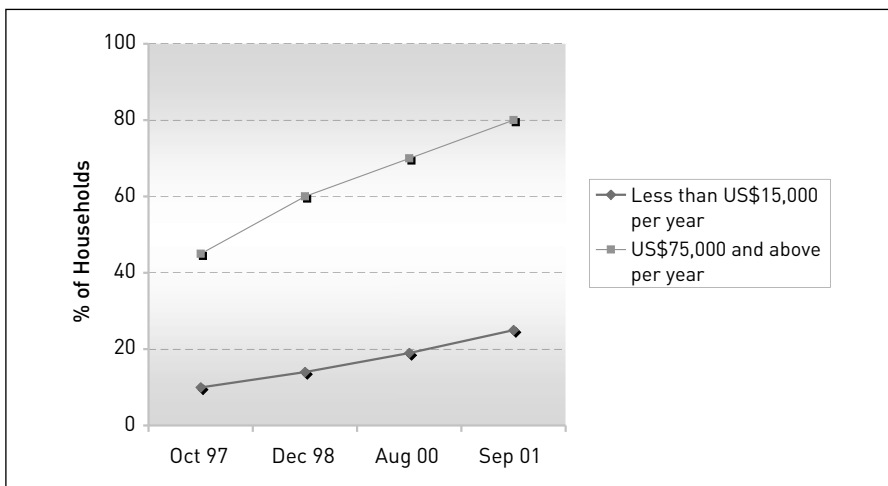


(Adapted from OECD, Telecommunications Database, June 2001)

In the fifty years from the end of the Second World War to the eve of the second millennium, computers evolved from bulky, room-sized apparatuses designed to calculate military firing tables to the compact, typewriter-sized devices found in a third of American homes, half of American workplaces, and in classrooms serving more than 70% of American students (Newburger, 2000). In less than twenty-five years – roughly half the evolutionary time of computers – the internet grew from a top-secret military computer network designed to survive a nuclear first strike into a popular information system. Its structural growth has been astounding – from a network of about 160,000 internet host computers in 1989 to 100 million host computers by 1999. In less than a decade – about half the time it took the internet to grow – the world wide web developed from an information-swapping technology serving a close-knit community of Swiss particle physicists into a cultural tidal wave of 10 million websites. It is estimated that there are 550 billion individual documents on the web as of 2000 (Bergman, 2001), and the amount of publicly available digital information is growing every day.

Such dramatic technological developments cannot help but be associated with significant social transformations, such as the economic and societal developments referred to at the beginning of this book (OECD 1996, 1999; EC, 2000). However, while these technological and social trends are global, they have not equally benefited all nations and groups of people. The concept of a *digital divide* between the haves and have-nots in the USA and globally is nearly a decade old, and it remains a constant concern, especially in a global perspective (OECD, 2001a; 2002). While this term originally referred to simply access to personal computers and other ‘new’ technologies, the accelerating growth of the internet in the 1990s quickly became the major thrust of what it meant to ‘be connected’ (to the web). Even as late as 2001, there were huge differences between even the industrialized countries that form the OECD, so that Scandinavian countries had nearly five times the per-capita connectivity as did countries such as Hungary, Greece and France (see Figure 6). And, while dramatic changes have taken place in access to hardware and in internet connectivity in the first few years of this century, major differences still exist between industrialized and developing nations (International Telecommunication Union, 2003). Furthermore, as noted in a major US Government publication (US Department of Commerce, 2002), the digital divide in the USA may well be shrinking if one considers the primary parameter to be ‘getting connected’. Indeed, Figure 7 suggests that the poor in the USA are gaining connectivity at least as rapidly as the more affluent.

Figure 7. **Internet Access (by Income) in the United States**



However, critics have reviewed the same data and suggested that the key parameter in the first decade of the twentieth-first century is not simply connectivity, but rather the *bandwidth* possessed. In terms of bandwidth, the poor are still as far behind the rich as when the rich were far ahead in ICT access alone. This is not a minor issue, of course, as educational multimedia is increasingly taking advantage of still and moving images which require large digital files that cannot be effectively utilized on low bandwidth, modem-based retrieval. Nowhere is this more obvious than in telecom-poor Africa, where internet access has been crippled by low bandwidth. In sum, in one form or another, the digital divide in hardware and connectivity is likely to remain *divisive* for a long time to come, and will clearly affect education and development choices.

There is another, more subtle digital divide that is rarely discussed, that of the *digital language* divide. In the field of literacy, there is

Box 5

Language development for literacy: The Shiyeyi-speaking people in Botswana

Since independence, the government of Botswana has practised an exclusive language policy, in which only English has been used in government circles, at the exclusion of all twenty-six languages represented in the country, with a limited use of the national language, Setswana. However, in recent years more positive statements have been made in Parliament regarding the use of other languages in education and society. Such statements have provided an environment conducive to NGOs developing other languages for use in public education and also out-of-school literacy programmes. One such organization is undertaking to revive the language and culture of the Shiyeyi-speaking people in north-western and central Botswana. By the 1990s, it was documented that most of these people, especially the young, did not speak Shiyeyi. Following some pioneering work by a South African linguist working with indigenous scholars, an organization was formed in 1995 called Kamanakao, 'the remnants,' to develop and maintain what remains of the Shiyeyi language and culture, as part of the overall national Setswana culture. The main strategy of the Kamanakao Association has been to conduct participatory training and research workshops in villages throughout the Shiyeyi-speaking region. These workshops have collected data with the aim of developing orthography, recording oral literature, and surveying speakers on their attitudes towards Shiyeyi with regard to preferences for literacy. In the past, adult literacy materials written in Setswana, the national language, have been largely unsuccessful in non-Setswana-speaking communities; in addition, children in non-Setswana-speaking areas have underachieved, year after year. The Shiyeyi-speaking people recognized the considerable benefit that could be derived from mother-tongue literacy in their communities. Literacy classes in Shiyeyi were started in several rural areas, and other areas have been targeted for future classes for adults and youth. (Adapted from Nyati-Ramahobo [1998].)

probably no other issue that has engendered as much debate and concern as language of instruction (Klaus et al., forthcoming; Hornberger, 1999; see also Boxes 5 and 6). There are those who strongly assert the need for literacy in the mother tongue and those who say that such programmes are far too expensive, and that social and economic dynamics are such that international languages are simply more cost-effective. While this issue is not a focus of the present book, the issue of language of instruction (LOI) is one that has special meaning when taken in conjunction with ICTs.

Box 6

Vernacular 'bridge' literacy in Egypt

The gap between the Arabic language of formal education and adult literacy (*fusha*) and the Arabic dialect or vernacular spoken at home, at the marketplace and most everywhere outside of school walls appears to be a major cause of low learning achievement rates in schools and low adult literacy in the Arab region. The significant linguistic distance which separates *fusha* from the learners' personal experience, familiar topics, and concrete real-world materials is a cause of serious pedagogical problems, leading to a lack of adequate language competence and learner self-confidence, as well as a poor quality of education, and high repetition and drop-out rates in formal and non-formal schooling. One method for improving this situation is the use of vernacular (or dialectal) Arabic as a 'bridge' literacy. The use of vernacular Arabic in the early stages of Arabic literacy is aimed at giving early assistance to adult learners. It makes the learning of the decoding skills easier by connecting the letters of the Arabic script to known and more accessible relevant language patterns and forms. Some NGOs are successfully using vernacular adult literacy in Egypt to improve the learners' motivation and learning achievement. The British-supported Egyptian Adult Literacy Training Project *Aswatna* ('Our voices') contains a selection of vernacular student writing with more than 100 pieces written by adult literacy students. Because it is the product of real-life experience, vernacular writing is now used to stimulate class discussions and promote an enhanced mobilization. [Adapted from Maamouri [1998].]

One reason for this is that the internet itself is *not* language-neutral. Indeed, recent research shows that English is more present (with 60% of total volume) on the world wide web (the web) than all other languages combined (Langer, 2001). Interestingly, the dominance of English has dropped somewhat from an even greater dominance only a couple of years earlier (65% in mid-1999). Still, no other language exceeds even 10% of the English total (German was in second place at 6% of overall web presence). Although similar data are not available for software production, a substantial dominance is likely to be found for English, at the expense of other languages, even the major

international (e.g. French, Spanish) and metropolitan (Hindi, Swahili) languages. National/local ‘minority’ languages (e.g. Telugu in India, with 50 million speakers; or Mayan in Mexico, with several million speakers) receive relatively little digital attention at all.

Of course, the digital revolution did not create this situation of language dominance, which has gone on for centuries and has been, as noted above, a source of difficulty for the print media in literacy programmes worldwide. Simply put, literacy programmes have found it difficult to teach in local LOIs for a set of well-known reasons, including: poor and insufficient materials in local LOIs; lack of research-based materials in local LOIs; and teachers who are poorly trained in local LOIs. These problems in local LOI print-based programmes have been around for a long, long time – and this is precisely an area where digital materials can make a difference. It is very possible that the language-based digital divide can be bridged more easily than the language-in-print divide, if only because translation and production costs in digital media are continually decreasing, while the costs of hardcopy printed materials are continually increasing. Indeed, one solution to this problem – and a way to promote ‘knowledge economy’ applications of the emerging literacy skills of the community – is to engage community members in the generation of web content in the local language that meets the needs of the local community. This is an area that will receive considerably more attention in the coming years.

2.4. ACCOUNTABILITY AND COSTS IN LITERACY EDUCATION

Beyond understanding aggregate level cross-national statistics, there is a need for rigorous and in-depth research on the effectiveness of literacy and education efforts. These should include both formative and summative evaluations of programme practices, ideally conducted by researchers who are independent of the planners. Studies would focus on planning and strategies for literacy work, programme implementation and management, student monitoring, attendance and retention, skill acquisition, integration with other agencies, and post-literacy activities. Progress has been accomplished in some of these areas, mainly in the areas of formative studies and post-hoc analyses of management; only in the last decade has serious work

in this field begun again (e.g. Burchfield, 1997; Carron et al., 1989; Easton, 1998; ILI/UNESCO, 1998; Okech et al., 1999; Wagner, 2003). Many programmes have inadequate documentation procedures, much less usable evaluation data (Diagne and Oxenham, 2002). With the expansion of interest in literacy worldwide, and with the push of the recommendations of the 2000 EFA-Dakar conference, far greater attention will need to be paid to rigorous and in-depth evaluation of literacy and adult education programmes. Indeed, it may be that one of the key impediments to expanding public and government support for adult literacy programmes has been the failure of those who support international adult literacy programmes to provide the type of reliable databases and impact evaluations typically utilized in other educational efforts.

In addition to understanding literacy levels as a statistical phenomenon, there is an increasing need to be able to analyse the effectiveness of literacy and adult education programmes as they operate in a variety of settings on the ground. These efforts, commonly thought of as programme evaluation work, constitute an important element in our understanding of literacy and adult education and of how service provision can be improved and expanded.

The cost of adult education programmes is assessed by the expenditure per person enrolled who completes the programme. Programme costs typically include everything from facilities, teaching materials, research, salaries, training and evaluation. The World Bank (Lauglo, 2001) estimates that the average cost per person in LDCs of completing a course (or unit cost) for its supported projects can range from US\$12 to US\$74. This does not include the implicit costs (such as income foregone) of participating in a programme. The wide range of unit costs among programmes indicates variation in programme efficiency, and most likely, programme effectiveness. This unit cost is sensitive to participant attrition, as disequilibrium in enrolment and completion rates drives the unit cost up.

Government-led adult education programmes are cheaper than agency-funded programmes, as low as US\$1.93 per person in Bangladesh to US\$50 in Senegal (Nordveit, 2004; Oxenham, 2000). This is because World Bank programmes incur most of their cost in management (e.g. facilitators, coordinators, operational expenses), whereas government programmes have the benefit of using already-available facilities. A crucial variable in calculating unit cost is time-

on-task – the amount of ‘time an average learner needs to master the basic skills of reading, writing and calculating sufficiently to sustain and use them helpfully in their lives’ (Diagne and Oxenham, 2002), which is the standard variable used in LDC evaluation studies. Of course, a major question remains about learning achievement when contexts are so diverse that seat time is nearly irrelevant. Clearly, there is a considerable need for improving accountability measures that will capture both time and achievement.

As will be seen below, the cost issue becomes even more critical when ICTs are added to the equation, as education policy-makers often see technology as an ‘add-on’ that must prove itself beyond the budgets already allocated to instruction. From this perspective, the value of ICT is measured by the extent to which the costs of hardware, software and networking infrastructure can be off-set by savings in more traditional delivery mechanisms, improved effectiveness or productivity in education, or increased access to education. An alternative perspective is to measure the value of technology by the extent to which it integrates education into broader social and economic developments and advances the goals of social and economic progress, a much more difficult quality to measure.

Technology in Support of Literacy and Basic Skills

There are two interconnected approaches by which ICT can be used to develop literacy and adult education. The first is to use technology to support the development of basic literacy skills. With this approach, the computational capabilities of computers can be used to deliver instruction in support of the cognitive skills needed to read and understand text. Basic literacy skill is not only of value in itself, but is also essential for using text to learn other important skills. Second, as literacy develops, technology can also be used to efficiently support adult education at a distance, when instruction and other resources might not otherwise be available. Further, the capabilities of ICTs are improving dramatically and these have significant implications for the support of these cognitive skills. These advanced technologies also have significant costs that have implications for policy decisions. We explore these possibilities and issues in this section.

3.1. BASIC LITERACY SKILLS

Traditional approaches to literacy focus on the skills of reading and writing text. Text reading involves processes of decoding and comprehension and is a cognitively demanding task for new readers (Just and Carpenter, 1987; Perfetti, 1989; Sabatini, 1999; Snow and Strucker, 2000) The reader must use decoding skills to convert the printed text into the mental equivalent of spoken words while at the same time constructing a mental understanding of what these words mean – that is, comprehend what the text is saying. These two processes interact, and they can help or detract from each other. For fluent readers, the process of text decoding is automatic, and most of the reader's cognitive resources are used to understand the meaning of the text. Conversely, an understanding of the text topic helps the reader figure out an unfamiliar word or difficult passage. However, the process is

slow for readers with limited decoding skills, and they spend more of their cognitive resources on the act of decoding. Consequently, there are fewer cognitive resources available for understanding the meaning of the text, and the slowness of the process makes it more difficult for readers to keep their understanding in memory so as to support decoding and continued comprehension. Also, the more unfamiliar or complex the subject matter of the text, the more challenging is the task of comprehension.

Decoding, especially the sounding out of words (in alphabetic scripts), is a major problem for adult illiterates, as research in the USA (Perfetti and Marron, 1995) and in LDCs (Abadzi, 2003) has shown. On the other hand, adult literacy learners have an advantage over young readers in that they often bring a strong sense of purpose, a significant amount of world knowledge, and – for those learning to read their mother tongue – a significant spoken vocabulary that they can use to help with decoding. While the specific purposes and background knowledge vary significantly among adults, the more the text deals with topics that are familiar and interesting to adults (rather than topics that are familiar and interesting to children), the more mental resources will be available to focus on building and using decoding skills, and the more motivated students will be to continue their engagement in the reading process. As decoding skills and comprehension strategies develop, these literacy skills can become more self-regulated and be used to understand increasingly challenging texts. They become a significant resource for further learning throughout one's lifetime (Chall, 1999). Thus, these basic literacy skills become the foundation for further, text-based instruction and learning.

The main productive component of literacy is writing (though many have argued that reading is mentally productive as well). While those new to writing may struggle with the psychomotor competencies needed to create simple letters and words, the emphasis in most writing assessments is on the cognitive skills needed to generate, draft, revise and edit ideas in written form (National Assessment Governing Board, 1998). At the most basic level, this would involve a command of spelling, grammar, punctuation and capitalization sufficient to communicate to the reader. However, more advanced writers should be able to express analytical, critical and creative thinking in well-crafted, cohesive written text, whether this is for narrative, informative or persuasive purposes.

Cognitive scientists characterize writing as a process in which the writers move back and forth between the text that they are generating and the goals of their writing, their plans for accomplishing their goals, their notion of an audience for their writing, their knowledge about the topic, and their assessment of the extent that the text generated so far has accomplished their goals (Bereiter and Scardamalia, 1987; Flower and Hayes, 1981). But these more complex, cognitive skills do not come easily for many learners. For example, in a recent US study (National Center for Educational Statistics, 2003), students in most grades showed significant improvements in writing skill compared to previous years, and yet most could not generate coherent text passages with clear language, supporting details, and creative thinking – a level of performance considered to be ‘advanced’. In brief, beginning writers often can generate simple text, but they have difficulty formulating their ideas and turning them into well-organized, coherent passages that accomplish specific goals for a specific audience. This book illustrates some of the differences between reading and writing skills, and points as well, in the sections below, to the varied ways that ICTs may be able to assist literacy learners of all ages.

In considering the use of new technologies for basic literacy skills, we focus both on how to structure effectively the use of technology to support the development of literacy skills, both in and out of school, and how to provide access to educational opportunities for adult learners.

3.2. ICTS IN SUPPORT OF BASIC LITERACY SKILLS

Increasingly, the use of new (and old) ICTs has become a topic of great interest to adult literacy educators, both in the USA and abroad (Askov et al., 2003; Rosen, 2000; Sabatini, 2001; Stites, 2004; Wagner and Hopey, 1998, Wagner, 2001). Technology can be used in two primary ways to support the acquisition of literacy skills, as traditionally defined. First, the capabilities of technology can be used to support development of the cognitive processes and basic skills involved in literacy. For the purposes of this discussion, the focus will be on beginning reading, which has received the most attention in ICT-based instruction. Second, technology can be used effectively to support the development of literacy skills for learning at a distance when instruction and other resources might not otherwise be available.

The first application of ICT draws on the interactive abilities of the computer. The computer has, compared with other (older) technologies, the nearly unique capability to accept ‘input’ and use this to determine its subsequent presentation of information or ‘output’. This input–processing–output capability can be used to develop computer-based tutorials that support the cognitive processes involved in reading, primarily those related to decoding. New developments in hardware and software are increasing the computer’s ability to provide such support; and, it should be noted, there are new tools – based on computer chips – that are called ‘talking books’ (e.g. *LeapFrog*; <http://www.leapfrogschoolhouse.com/home/index.asp>), which do not require a computer but offer some of the same enhanced interactive capabilities.

Computer-based tutorials and reading. One-to-one human tutors have been found to have substantial positive and long-lasting effects on the skill development of early youth readers, especially when certified teachers were used as tutors (Wasik and Slavin, 1993); the data are less clear with adult readers in the USA (Wagner and Venezky, 1999). Unfortunately, LDCs have a significant shortage of trained teachers for classroom instruction, let alone for one-to-one tutoring. Computer-based tutorials – sometimes referred to as ‘computer assisted instruction’ or CAI – augmented by multimedia capabilities may be able to provide the learner with the skilful interaction that human tutors can otherwise provide. The available data on CAI innovations in early reading instruction to date come primarily from research on American schoolchildren, as detailed below.

A typical lesson involves the presentation of instructional information in one or more of a variety of forms, such as text, sound, pictures and video (Alessi and Trollip, 2000). This multimedia capability is particularly important for new readers because it supplements their limited ability to use text for instruction by providing spoken information and pictorial content. In turn, the student is asked to enter some kind of response into the computer, such as selecting the best choice of multiple choices presented. The software then provides feedback to this response, usually telling the learner if his or her response is correct, and, if it is not correct, why not, and what the right answer is. With newer and better-designed tutorials, feedback will be specifically tailored to the kind of error that the learner has made. The

analysis of the learner's response will also determine the information that he or she receives next. This type of interactivity is rarely available for individual students in classes with large enrolments, and in such cases the customization of subsequent instruction is, perhaps, not at all feasible. These characteristics of tutorial software represent, at least in principle, a significant benefit to, or advantage over, classroom instruction and account for their appeal.

More powerful computers are needed to present multimedia instruction. And until recently, the software for even the newer, multimedia computers has been limited in its ability to accept and analyse a variety of responses. But these capabilities are changing, as discussed later in this section, and these changes have significant implications for the needs of literacy learners.

Literacy tutorials can use the interactive capabilities of computers to help learners build their cognitive skills of decoding and comprehension. Tutorials focusing on decoding skills can be used to teach word recognition, phonetics, pronunciation, grammar, word usage and vocabulary. Often delivered on a disk or CD-ROM, these tutorials typically present some information on a target skill – such as description of a decoding strategy – along with some examples of its use and problems or exercises in which the learner applies the strategy. For example, in developing a phonetic decoding strategy in English, the software programme might present several words with the same phonetic base, both as text and sound, and note the similarity in the graphemes (i.e. letter groups) and phonemes (i.e. sounds) of these words. The tutorial might then provide additional words with the same phonetic base, and students would be asked to apply the decoding rule to read these words. The computer could analyse the student's response, comparing it to the right answer and various phonetic errors that students typically make, and provide feedback based on this analysis. Extensive practice can build speed and fluency, so tutorials could offer many similar exercises in which the rules and strategies are applied. Tutorials that emphasize comprehension could provide students with text passages of increasing length and complexity. The presentation of pictures along with the text can help students use their knowledge of the text topic to support both comprehension and decoding (Kozma, 1991c; Mayer, 2001). The software could ask students for responses that show their understanding of the meaning of the text, and the computer could, in turn, provide feedback.

Many literacy tutorials exist for the English language, but most are designed for young children. A few are specifically designed for adult learners, often for learners of English as a second language (ESL). For example, *Lexia Reading Strategies for Older Students* (Lexia Learning Systems: Lincoln, Mass.) is designed for students ages 9 through adult. Activities provide practice in decoding skills, early comprehension and keyboard skills. Students control their own activities, but they must show competency and fluency in each skill before moving on to the next. *English Mastery* (American Language Academy: Rockville, MD) is a set of four CD-ROMs designed for ESL students and provides intensive practice in listening comprehension, speaking and pronunciation, reading comprehension, writing and dictation, the fundamentals of English grammar, and vocabulary development. Built-in authoring tools allow teachers to make additional lessons. For a recent experimental study of ESL, see Hannah et al. (2004).

Literacy tutorial software can be expensive, often costing several hundred US dollars or more. Further, since the programmes are designed to be used by students individually and for over long periods of time, the required computer-student ratio is relatively high for these tools. However, these programmes are now mainly delivered on CD-ROMs and designed for stand-alone machines, so access to the internet is not required. This fact and the need for a high computer-student ratio present significant barriers to the use of this approach for developing countries, or for literacy for non-English speaking adults in the USA. Investments are required both for a sufficient number of multimedia computers to service the learners and for the development of well-designed tutorial software targeted for adults. If there is sufficient programming and instructional design capacity in a country, the development of educational software in literacy and other instructional areas could be justified both in terms of supporting individual learning and in improving the quality of instruction by teachers or tutors. These issues will be discussed further below.

Word processing and writing. Word processors were among the earliest applications developed for personal computers, and teachers of writing were among the earliest adopters of technology to support education. The technical skills involved in using word processors have now become an important part of ‘computer literacy’. The

growing availability of personal computers and word processors in the 1980s, at least on college campuses in the USA, coincided with the emergence of the cognitive theories of writing mentioned earlier. These theories found their application at the college level in a 'process approach' to the teaching of writing. With this approach to the teaching of writing, the focus shifted from the attributes of a well-written text, as represented by the classic works of literature, to the cognitive processes of planning and creating a written text – setting a purpose and audience for the text, organizing information, transforming ideas into text, reviewing it relative to the purpose, and revising (Hayes and Flower, 1986). Teachers saw the word processor as a way to support this process. The use of word processors during the writing class allowed the teacher to focus on and observe writing while it was in progress and to encourage students to plan and revise as well as generate text (Britton and Glynn, 1989; Daiute, 1985; Hawisher and Selfe, 1989). An extensive review of experimental studies of the use of word processors for the teaching of writing found significant favourable effects (Bangert-Drowns, 1993). Other software tools, such as outlines and idea organizers, can provide additional features and prompts that support the efforts of early writers as they struggle to master the writing process (Kozma, 1991a).

One caveat is relevant to the present discussion. It has often been reported that one of the most troublesome skills for literacy learners in LDCs is that of *handwriting*. Indeed, some specialists have argued that the (frequent) initial emphasis on having 'neo-literates' write their names and 'produce' text as a way toward empowerment is one of the most difficult (and sometimes demotivating) aspects of literacy learning. There are numerous anecdotes on both sides of the issue of early writing emphasis, but there is little debate about the difficulty that many adults have in producing handwritten text. The word processor and keyboard may seem intimidating to new literacy learners; yet, on the other hand, the 'professional' appearance of the final product of a word-processed document may provide an offsetting motivation. And even 'hunt and peck' typing may be less challenging and embarrassing than the struggle involved in using handwriting to form letters, words and sentences. This is one of the founding assumptions of the 'writing to read' approach that has been successfully used with both very young (Murphy and Apple, 1984) and adult literacy learners (Begg, 2002). With this programme, new readers use computers and

word processors to write – and, in turn, read about – topics that are important to them.

3.3. ICTS IN SUPPORT OF DISTANCE LEARNING

Another major application of ICT to support adult education is distance learning, which is often used where there are insufficient numbers of qualified and trained teachers. For this reason, distance learning is playing an increasingly important role in developing countries (UNESCO, 2002b). The roots of distance learning go back to correspondence programmes, primarily in higher education, with the earliest programmes in developing countries being in the Philippines (in 1940) and Indonesia (in 1955). With the development and dissemination of radio and television, developing countries used these technologies to address the educational needs of remote populations. Beyond these traditional technologies, ICTs are now playing a role in creating ‘virtual classrooms’ that support distance learning. E-learning is at present focused mainly within higher education, and is growing rapidly in adult education in the USA (Askov et al., 2003). Each technology may allow adult learners to access otherwise unavailable resources and use their growing literacy skills to further their education. Since the primary use of technology in poor countries remains in radio and television, where there has been some evaluation research, it is useful to provide a summary before moving on to new ICTs where less solid research exists.

Educational radio and television. As broadcast technologies, radio and television have the advantage of leveraging costs (initially for the production and distribution facilities and subsequently for the production of individual programmes) to address the needs of a large number of users over distance and, with rebroadcast, over time. For example, the UNESCO/UNICEF Gobi Desert Project in Mongolia (see Box 7) used radio to deliver education to 15,000 nomadic women in literacy skills, livestock rearing techniques, family care, income generation and basic business skills (Perraton and Creed, 2002). The radio programme included visiting teachers and small information centres that serve as meeting places for learning groups. *Telesecundaria*, a secondary-level education television series in Mexico, served over 800,000 students during the 1997–98 school year (Wolf et al., 2002). By 1990, China,

India, Indonesia, the Islamic Republic of Iran, Pakistan, the Republic of Korea, Sri Lanka, Thailand and Turkey had all used broadcast media to set up national open universities, most of these institutions having more than 100,000 students, with 400,000 at the China Radio and TV University (Perraton and Creed, 2002).

Box 7

Gobi women and distance education in Mongolia

In the face of major political change, survival may depend on each individual's opportunity and ability to learn new skills and practices. But in a country with a widely scattered population and few resources, how can instruction effectively reach those in need? Non-formal distance learning may prove crucial in helping populations in such circumstances to survive. The 1990 transition from communist to democratic economy devastated the rural population of Mongolia, particularly the nomadic people of the Gobi Desert. In the wake of this change, a tremendous burden of labour and management of livestock fell to the women and those children kept out of school to help. Women's traditional roles now included taking care of the animals and using meagre resources to produce marketable goods – tasks requiring skills that had been relied on sixty years earlier and that by now were unfamiliar, forgotten, or in need of improvement. The Gobi Women's Project, started in the early 1990s, is a non-formal distance-learning programme utilizing print and radio lessons to communicate and renew a number of survival and income-generating skills important to the nomadic women of the Gobi Desert. The project provided radios, as well as the necessary batteries and relevant booklets. Learning materials were supplemented by newsletters, demonstration materials and information sheets. Teachers travelled to the women's homes to check their progress and help them with any specific problems. The programme covered such topics as health, survival and income generation and business, as well as literacy and numeracy. Participants reported that not only were they satisfied with the new skills they acquired through the programme, but they also enjoyed the interaction with teachers and other learners and gained a sense of self-sufficiency within their environment. (Adapted from Robinson [1997].)

Historically, educational broadcast programmes started off in 'talking head' format and were designed to distribute information to large numbers of students very inexpensively. However, the lack of interactivity and, in the case of radio, the lack of visuals significantly limits the instructional support that can be provided to students. More recent developments have found ways to 'work around' some of these limitations.

For example, interactive radio instruction (IRI), uses a methodology that requires learners to stop and react to questions and exercises through verbal responses to radio characters, engaging them in group work and physical and intellectual activities while the radio pro-

gramme is on the air (Bosch et al., 2002). Short pauses are provided throughout the lessons, after questions and during exercises, to ensure that students have the time to think and respond adequately. Typically used in formal classroom settings, the programme also encourages interaction between the teacher and learners as they work together on problems, activities or experiments. Materials and activities in the classroom compensate for the limited ability of radio to provide information in various forms and to give students feedback on their responses.

IRI has been widely used to support primary education in developing countries, ranging from the Nicaragua and El Salvador to Bolivia, Kenya, Nepal, Thailand and Indonesia. English in Action, an IRI programme for primary students in South Africa, served nearly 25,000 students in 1995. In Guinea, IRI was used along with printed materials to help move the country's educational system from one which focused on a lock-step curriculum, teacher-centred instruction, and rote memorization to one in which students interacted more with each other and with teachers, as a result of IRI activities. The IRI programmes would prompt teachers to pair students for certain activities, thus facilitating cooperative learning; they prompted teachers to call on girls as well as boys; and they posed questions directly to students that required higher-order thinking skills such as problem solving and analysis. Bosch et al. (2002) reviewed studies that showed that IRI contributed to reducing the equity gap between rural and urban students and between girls and boys. In Bolivia, Thailand and South Africa, rural students participating in IRI showed higher gains, relative to control groups, than did participating urban students. In Papua New Guinea, Honduras and South Africa, girls gained more than boys.

Probably the best-known application of educational television is *Sesame Street*, which airs in 140 countries around the world. In China, it is called *Zhima Jie*; in South Africa, *Takalani Sesame*; and in Egypt, *Alam SimSim*; and it is preparing children in 140 countries around the world to begin school and literacy. For example, in Egypt, more than 90% of children under the age of 8 (more than 4 million children) in urban areas and 86% of children in rural areas watch the show (Ward-Bent, 2002). Significantly, 54% of mothers regularly view the series.

However, for older students, educational television is more often used for basic education. With these applications, television

programming is coordinated with a formal curriculum and with in-school or out-of-school activities. *Telecurso 2000*, in Brazil, is targeted at young adults who left primary or secondary schools before graduation. In the early 1990s, the programme was started as a joint venture between the Federation of Industries, the State of Sao Paulo and the Roberto Marinho Foundation, with the aim of increasing the skills of the workforce. It is a condensed version of the basic secondary curriculum, which is provided through a combination of direct television, videotaped classroom sessions, and books. The goals of the programme are to provide people with the basic skills of reading, writing, counting and solving mathematical problems; to prepare them for jobs; to promote their participation in civic and cultural life; and to give them skills that they can use in their daily lives. At present, more than 200,000 students attend classes in factories, schools, churches, offices, prisons, ships and buses (Wolf et al., 2002).

Telesecundaria was designed to respond to the needs of rural Mexican communities where general secondary schools (Grades 7–9) are not feasible (Kelley-Salinas, 2001). In 1998, nearly 18% of the country's total enrolments in those grades participated in the programme (Wolf et al., 2002). *Telesecundaria* is an integrated and comprehensive programme providing a combination of distance and in-person support to students and teachers. The programme puts teachers and students on the screen, brings context and practical uses of the concepts taught, uses images and available clips extensively to illustrate and help students, and enables schools to deliver the same secondary school curriculum offered in traditional schools. The students watch fifteen minutes of television, the set is turned off, and the next forty-five minutes students work under the direction of teachers and workbooks. They might read aloud, apply what was taught in practical exercises, and participate in a brief evaluation of what has been learned.

Virtual classrooms. While broadcast radio and television have had a long history in distance education, the use of the computer to create virtual classrooms at a distance is quite new and has not yet taken hold in most developing countries. But despite its recency, the practice has become quite common in industrialized countries. Relying extensively on the internet and web, virtual learning can either supplement an existing face-to-face class or entirely replace the face-to-face experience, with

learners never meeting their teacher or other students (Harasim et al., 1995; Hiltz, 1995; Palloff and Pratt, 1999, 2000; Zucker and Kozma, 2003). Indeed, some virtual experiences eliminate the teacher's role altogether or reduce it to an available online advisor, relying instead on the student's interaction with extensive online materials. Alternatively, the programme may try to reproduce the face-to-face experience online, with teachers and students holding electronic discussions in a virtual space, either synchronously or asynchronously. These meetings may be conducted as online 'text chat' or by using more sophisticated and expensive teleconferencing equipment. These environments make significant demands on text-comprehension skills, as well as on motivation and the self-direction of learning.

The use of virtual classrooms started at the university level, where computers have been much more prevalent than in schools and homes. But over the last five years, there has been a significant growth in its use for secondary education. For example, the Virtual High School (VHS) project in the USA included participating schools, which would pay a participation fee; and one of their teachers (who had received special training, also online) would offer an online course in the VHS catalogue. The participating high school, in turn, would receive twenty-five 'slots' in which any of their students could enrol in any of the courses in VHS's catalogue. The teacher would post a syllabus, assignments and a student roster, all online. The course would start at the beginning of the school year and either finish at the end of the semester or, for a two-term course, the end of the year. Course materials might include text documents that the teacher posted, other multimedia materials, or other sites on the web related to the topic of the course. Students and teachers exchange email or, more typically, engage in ongoing, online discussions related to the assigned topics. Students turn in their assignments online, and they might exchange and discuss these or the teacher might just grade and return them. By 2000, VHS had enrolled more than 3,000 students from all over the country in about 150 internet courses on topics that ranged from anatomy and physiology to poetry, economics, world religions and foreign languages. In their five-year evaluation of the project, Zucker and Kozma (2003) found that principals, teachers and students all overwhelmingly supported the programme, primarily because schools could offer, teachers could teach, and students could take courses that would not otherwise be available at the schools. The quality of the

courses was generally judged to be high; and in a comparison study, VHS students scored, on assessments, as high as, or higher than, students in the same courses offered by the same teachers face-to-face.

Virtual learning is beginning to be used in developing countries as well. At the postsecondary level, one of the most ambitious efforts is the African Virtual University (AVU). Organized under World Bank auspices in 1997, AVU has established thirty-one learning centres at seventeen currently participating universities in African countries, working with partner universities in developed countries. Using a combination of online materials, online chat, video broadcasts, CD-ROMS and DVDs, the AVU has delivered over 3,000 hours of instructional programmes to over 23,000 students.

At the secondary level, the World Bank started the World Links for Development (WorLD) programme as a pilot project in 1997, as a way to install networked computers in high schools in developing countries. Since renamed 'World Links', and spun off as a separate non-profit organization, the aim of the programme is to establish global, educational online communities for secondary school students and teachers around the world in order to expand distance learning opportunities, enhance cultural understanding across nations, build broad support for economic and social development, and train teachers to integrate information technology into the classroom. The programme has grown from connecting a single school in Uganda with one in Canada during its first year, to serving over a thousand secondary schools in twenty-six developing countries in Africa, Latin America, the Middle East, and Southern and South-East Asia. In a three-year evaluation of WorLD, Kozma et al. (2004) found that despite barriers encountered by WorLD teachers, students in the programme were more likely than comparison students to engage in classroom practices that are often cited as important for preparing students for the global knowledge economy, activities such as gathering data for a research project, collecting information about another country or culture, and collaborating on a project with students from another country.

These two projects, as with others in developing countries, use online resources to supplement formal education and provide students with educational resources that would not otherwise be available.

Online adult education in the USA. The United States has an important confluence of both high need of adult basic education and the finan-

cial means to support a robust ICT-based development programme. In a recent review, Askov et al. (2003) describe several new efforts in the USA to provide online distance education to the adult education community. The most robust effort to date is *LiteracyLink* (see Box 8), which was conceptualized, planned and implemented at the beginning of the internet revolution in the mid-1990s. As a result, many of the early field tests of *LiteracyLink* focused on the problems that teachers and learners had in gaining reliable modem access to the web. Of course, the situation has changed dramatically since that time, and most programmes in the USA today have reasonable, and sometimes quite fast, connections, as well as good hardware. An implementation study using *LiteracyLink* was subsequently undertaken in the state of Pennsylvania and completed in 2002. Among the important findings were that adult learners showed strong motivation when actually in the programme. However, as with most non-online programmes, retention remained a problematic issue, with an average of only about 40% of learners retained in the evaluation study (Askov et al., 2003, p. 40). This rate is within the average range of adult education programmes more generally, and points to the complexities of using distance education to reach those ‘anywhere at anytime’. The evaluation study did

Box 8

***LiteracyLink*: internet-based adult basic education in the United States**

In 1996, the US Department of Education committed five years of support to the Public Broadcasting Service, the National Center on Adult Literacy at the University of Pennsylvania, and Kentucky Educational Television to build, for the first time, an instructional system using the latest in video, online and computer technology to help adults receive literacy instruction and gain high school diplomas or equivalencies in the United States – in a programme known as *LiteracyLink*. This programme is designed to serve the more than 40 million Americans who require basic skills instruction. As an online lifelong-learning system, it incorporates the latest internet technologies (Java and streaming video), video technologies (digital, closed-circuit, broadcast, satellite), and computer technologies (digitized audio and video, computer-generated graphics, interactive multimedia, and text). *LiteracyLink* has two major goals: (1) increase the access of adults to learning opportunities that will enable them to obtain their high school diplomas, and (2) improve the quality of instruction available to individuals and adult literacy providers nationwide through enhanced resources and expanded staff development. As of late 1999, thousands of adult educators in dozens of sites across the USA have participated in the teacher training part of the project, which incorporates an electronic community of teachers, a series of online workshops with professional certification, a collection of websites that have been evaluated for adult learning, and a database of internet-based lesson plans. (Adapted from Wagner and Hopey [1999].)

show some evidence (based on teachers' estimates) that about half the enrolled learners would have been less likely to participate had there been no online service available. Other state-based experiments are underway in the USA, as well as in other industrialized countries. As globalization continues, it should be expected that innovations, wherever created, will find their way into the work of other countries and regions (Wagner and Hopey, 1998).

3.4. ADVANCES IN TECHNOLOGY AND IMPLICATIONS FOR LITERACY LEARNING

There have been a number of recent software and hardware developments that can allow computer-based instruction to address the cognitive needs of literacy learners, particularly those related to reading comprehension. Computers have come a long way in their ability to *present* information in a variety of forms. But, as mentioned above, they have been limited in the kinds of *input* they can receive and their ability to *analyse* and respond to input with any sophistication.

From the standpoint of the computer, the easiest kind of input for it to accept and analyse is a simple mouse click on a multiple choice or true or false answer. In the design of tutorial software, this input capability would be used to present several alternative answers to a problem and ask the learner to click on one. The software would be programmed to then give feedback appropriate to the correct or incorrect choice. This is also the easiest kind of response for the student to make. And because it is inexpensive to programme, this strategy is commonly used in tutorial software.

However, asking students to give simple responses and providing them with simple feedback does not match with the complexity of the cognitive requirements of the reading task. For early decoding skills, students need to be able to speak the sound of a presented word, phrase, or sentence, and the computer should be able to accept this speech, know if it is correct or analyse how it is incorrect, and then provide appropriate feedback and subsequent instruction based on the analysis of this speech. Furthermore, the learner may even want to be able to enter a word and have the computer 'read' it (i.e. produce its sound). Or, second language learners may want to enter a word in their own language and have the computer translate it, or ask for the translation of a word in the language they are acquiring. For

comprehension, students need to be able to input their understanding of what the text means. The ability to enter a lengthy response in the student's own words would correspond to the growing sophistication of the learner's comprehension abilities. The students' input could be spoken or written – itself a literacy skill. The computer should be able to respond to the meaning of the input or to its grammar, word usage, and so forth, as appropriate to the goals of the instruction and the needs of the learner. Currently, the ability to do these things is limited in commonly available software and hardware.

Fortunately, advances are being made on all of these fronts. However, these more advanced technologies have only recently become commercially available and begun to be used for literacy instruction. The more sophisticated of them make significant computational demands on the hardware and/or they require special additions to the computer and or expensive machines. Consequently, their near-term potential for literacy instruction in developing or even industrialized countries is still fairly limited. But, as with similar technological advances in the past, the cost of these capabilities will drop over time, and they hold promise for the future.

Speech recognition in support of decoding skills. Of these technological advances, the one in widest current use is speech recognition. With this technology, the user speaks a word or phrase into a microphone hooked to a soundboard in the computer, and the computer matches the sound to a model sound pattern in its memory. This technology has been around for some time, but in the past it has required the capabilities of large, very expensive computers found only in laboratories. It also required a substantial pre-training of the machine. That is, the model of the sound pattern would be created by having a specific user enter these sounds, perhaps several times for each sound, and it would have to be trained again for different users. It would also have to be trained and used in an otherwise soundproof room. The advantage of this technology is that speech recognition software can now accept input from a variety of speakers, with little or no training, and it is better at distinguishing student verbalizations from other sounds in the room. Importantly, the software can run on commonly available multimedia computers. For example, with *Dragon Naturally Speaking* (ScanSoft: Peabody, Mass.) the training time is about five minutes for computers with 400 MHz or higher processors. After training, the

software can create text documents from dictation at up to 160 words per minute. The software is available in several languages, including US English, British English, French, Spanish, Italian and German.

In addition, speech recognition technology is currently used in commercially available second-language tutorial software, such as the *Learn to Speak* series (Broderbund: Novato, Calif.). With these packages, the student can read a text word or respond to a question with a simple spoken response. The technology is used to help students build relatively simple speaking skills, such as word pronunciation, verb declension, and so forth. Speech recognition technology is also beginning to be used for children's learning of literacy decoding skills, for example, with *Let's Go Read* (Edmark: Novato, Calif.).

Going in the other direction, text-to-speech technology is also beginning to find commercial applications. For example, *CoolSpeaking* (Peach Seed Software: Powder Springs, Ga.) can read text from emails, web pages, or typed text. *Keystone ScreenSpeaker* (Words Worldwide Limited: Newcastle upon Tyne, UK) is a screen reader programme that allows the user to highlight text and have it read back to them, word by word, or sentence by sentence, or paragraph by paragraph. This allows students with limited literacy skills to use screen text to support their learning, if the difficulty level of the text goes beyond their decoding skills. Using another platform altogether, *LeapFrog* (mentioned earlier) has 'talking books' based on a stylus and a battery-powered computer chip that provides text-to-speech capability to early readers, primarily, at this point in their marketing, young children. Given the low cost and low maintenance needed by *LeapFrog* tools, this is a technology that may have considerable merit in LDCs.

Artificial intelligence in support of comprehension skills. The developments that may (eventually) make the greatest contribution to the learning of comprehension skills are the more 'intelligent' ones. These are applications that use one or another approach to artificial intelligence (AI) to give the computer a greater understanding of the user's input and be able to adjust the instruction in a more sophisticated way. Simple AI is used in some of the 'input-output' technologies, such as speech recognition. But more advanced applications of AI go beyond understanding the student's input of a well-anticipated word or phrase, to accommodate lengthy responses of relatively unexpected content. These advanced AI technologies are still in the research

laboratories, and those that have made it out into the classroom are typically in knowledge domains such as Algebra (Koedinger et al., 1995) that avoid the ambiguities of language. But there are important developments in AI that address the complexities of natural language use, and these have important implications for computer-based literacy instruction.

A particularly interesting experimental development illustrates the potential that these advances have for supporting the acquisition of text-comprehension skills. *AutoTutor* (Graesser et al., 2001) uses a number of language analysis techniques, including Latent Semantic Analysis (Landauer et al., 1998), to construct an understanding of the student's input. The *AutoTutor* simulates a typical human tutor conversation with a student in an attempt to comprehend a student's understanding of a specific topic, for example Physics, and to simulate the instructional moves of human tutors. *AutoTutor* appears on the screen as an animated talking head that acts as a dialogue partner with the learner. The talking head uses synthesized speech, intonation, facial expressions and gestures. *AutoTutor's* questions to the student are not the fill-in-the-blank, true or false, or multiple-choice questions that are popular with more-traditional computer-based tutorials. Instead, the questions invite lengthy explanations and deep reasoning (e.g. answers to why, how, what-if questions). The goal is to encourage students to articulate lengthier answers that exhibit understanding. Currently the learner uses a keyboard to input his or her conversational contributions, although the researchers on the project are exploring the use of speech recognition technology to accept the student's speech as input.

Another AI-based reading tutor does use speech recognition. Project LISTEN's *Reading Tutor* listens to children read text out loud and interacts with the student to build both decoding and comprehension skills (Mostow et al., 2001). The authors report on an experimental study with second and third graders that compared the *Reading Tutor* to human tutors and a classroom control group. The groups were compared on both process variables (i.e. words read) and outcomes (i.e. test scores). Human tutors outperformed the *Reading Tutor* only on measures of word attack skills.

AI is not yet a reality for most learners, especially in LDCs. Yet, the promise that AI offers for literacy learning is that the computer will develop the ability to understand the complex range of linguistic

responses that a learner might provide when trying to understand difficult text passages, and a computer-based tutor can then provide assistance on the appropriate comprehension strategies that would improve the learner's reading ability. It remains an open question as to whether this – and other technological advances described here – can be delivered in the short-term on affordable equipment, and whether the significant investments which would be required to use these technologies to develop literacy tutorials – in the languages needed by LDCs – will be made. The investment required to develop and use computer-based tutorials may be justified most when skilled literacy teachers are not available in sufficient numbers to provide students with personalized instruction – instruction that is necessary because students' lack of literacy skills limits their ability to take responsibility for their own learning. The coming decade will likely provide some interesting and important developments that take advantage of AI, even on fairly simply platforms such as handheld devices.

3.5. CALCULATING THE COSTS OF ICTS IN EDUCATION

As many have pointed out, the cost of technology has been, until relatively recently, too high for the disadvantaged, even for industrialized countries' educational programmes, not to mention the developing countries. But the price-to-power ratio (the relative cost, for example, of a unit of computer memory or the speed of processing) continues to drop sharply. While the cost of the average high-end microcomputer has remained constant for about a decade, the power of the year 2003 computer is more than 1,000 times greater than that produced by a PC in 1980. Further, the number of internet hosts grew 1,100 times between 1992 and 1999 (Haddad and Draxler, 2002). In addition, the computer's ease-of-use has grown tremendously, so that even the most powerful computers today are often much easier to use than the less powerful models of only a few years ago.

More specifically, however, it has been noted that general cost is a parameter too blunt for most educational decision-makers. Indeed, there are several preliminary questions to consider, which have been adapted from Haddad and Jurich (2002), such as:

- Desirability. How much does a project respond to identifiable needs, and will it be able to attract sufficient resources for success?

- **Feasibility.** Is the project one that can be accomplished within a reasonable timeframe, with sufficient human and fiscal resources?
- **Affordability.** Is the project cost-effective? Here the issue is not the ‘inexpensiveness’ of the intervention, but rather whether it does at least as good a job – if not a better job – at improving the quantity and quality of education, without going beyond the available fiscal constraints.
- **Sustainability.** Can the project survive? Are there multiple funding mechanisms, including income generation, which will help give initial interventions a longer shelf-life?

Of course, these are only a few of the key questions. But how do the data, especially on literacy and adult education, stack up in terms of costs? Alas, the contemporary knowledge base on ICT for literacy and adult education is very slim (as is the financial dimension of literacy itself (Lauglo, 2001). Nonetheless, some data are available, even though much is dated and uses ICTs that are now considered out of

Table 3

Costs of some adult basic education projects			
Currency: 1998 US dollars			
Project	Scale and duration	Cost per learner	Cost comparison
Radio schools in Latin America (e.g. Acción Cultural Popular [ACPO], Colombia; Radio Santa Maria, Dominican Republic)	ACPO: 190,000 students RSM: 20,000 students One-year course offering equivalency to primary education	In range of US\$50 to US\$88 per student, per annum	Cost at ACPO less than for primary schools. At RSM, comparable with primary, but lower than evening classes.
Zambia radio education campaign on cooperative movement	4,730 participants Ten weeks of meetings, once weekly	US\$22 per student	Cost per learner lower than cost of training at farmer’s centre, higher than primary school costs.
Functional Education Project for Rural Areas, Pakistan	1,500 students Eight meetings, at weekly intervals	About US\$46 per student	Cost probably low in comparison with alternatives, but high as compared with primary schools.
<i>Telesecundaria</i> ,* Mexico		In range of US\$441 to US\$589 per student	Cost per learner has been relatively stable over a long period. Costs understood to be of similar order of magnitude to costs in conventional schools.
<i>Source:</i> Perraton (2000)			
* Figures from three studies in 1975, 1988, 1997. One further study in 1981 had figures of US\$927.			

date. Based on data in Table 3, we can see that a variety of technologies have been used, with per-learner costs ranging from US\$22 to US\$589; of course, these figures tell us little about the real per-learner costs, the amount of learning achievement, or how money was distributed across types of specific expenses.

In the review cited earlier (Haddad and Jurich, 2002), there is a helpful analysis of cost structures. Namely, in order to make realistic cost estimates, one needs to take into account the following equation: $TC = FC + VC(N)$, where TC is Total Cost, N is the number of learners served; FC are the Fixed Costs, such as minimum infrastructure (e.g. internet basics); and VC are the Variable Costs or ‘recurrent costs’, such as training, related to the numbers of participants (learners, teachers, etc.). In general, what may be seen is that cost-effectiveness can be influenced greatly (and positively) by the ‘reach’ of a given ICT solution, especially if FC can be controlled. Thus, IRI, as described earlier, has one of the lowest rates of unit costs (between US\$1 to US\$3 per learner), as the denominator in many countries goes into the hundreds of thousands of individual learners. Of course, considering cost-effectiveness only by the above equation necessarily ignores the parameter (and critical issue) of learning achievement. Further, it is one thing to know that youth and adult learners are being reached, and quite another to know whether individual lives are being improved as a consequence of this. What is missing from most of these cost analyses (such as in Table 3) is learning effectiveness. Even in one of the better recent ICT evaluation studies, on WorLD’s work in Africa, relatively little direct data was obtained on actual learner achievement and none on costs incurred (Kozma et al., 2004).

Even with these limitations, it is instructive to look at one specific domain – teacher training – for which there exists not only somewhat more reliable data, but also some comparison to non-ICT comparable programmes. In Table 4, ICT-based teacher education is compared in several developing countries, along with comments concerning cost and effectiveness. While some of the data are quite old, they suggest overall that ICT-supported teacher training programmes may work well and are not very expensive. More recently, in the WorLD programme, Carlson and Gadio (2002) report that their ‘full programme’ would cost about US\$625 for a full 250-hour programme, a cost well within the parameters of what many governments spend on teacher training without ICT.

Table 4

Costs and effects of some international teacher-education projects					
Currency: constant 1998 US dollars					
Country, project, date	GNP per capita at time of study		Student numbers	Average cost in US\$	Educational and cost impact
	Date Current US\$	1998 US\$			
Tanzania TTD 1979-84	1982 310	524	15,000 p.a. 45,000 total	1,863 per student p.a. 7,316 per graduate	Effects comparable to conventional education. Cost about half conventional education.
Brazil Logos II 1976-81	1978 1650	4,125	24,400	211 per student p.a. 741 per graduate	80% pass rate. Costs lower than alternative.
Sri Lanka 1984-8	1986 410	610	c.5,000	116 per student p.a.	Cost 1/6 to 1/3 of alternative. More effective than alternative for some subjects, but less effective for others.
Indonesia 1985-8	1986 530	788	c.5,000	805 per student p.a.	Cost about 60% of equivalent. More effective than alternative in languages, but less so in mathematics.
Nepal RETT Basic teacher training course 1978-80	1979 130	292	3,000	196 per student p.a.	Cost slightly lower than alternative; completion rate 83%, pass rate 57%; no evidence that less effective than alternative.
Nigeria National Teachers Institute 1978-89	1984 730	1,145	20,327	79 per student p.a.	Cost probably lower than regular colleges; completion rate estimated 42%, pass rate estimated 27%, both rates higher than those of regular colleges.
Pakistan Primary Teacher Orientation Course 1976-86	1981 330	592	83,658 total enrolment 31,674 completed	107-149 per successful completer	Cost per AIUO graduate 45%-70% of conventional university.
Kenya in-service teacher training 1968-77	1972 180	661	790	806 per subject equivalent p.a.	Cost relatively high; favourable effect on access.
Kenya University of Nairobi BEd 1986-90	1988 370	510	515	1,096 per student p.a.	Cost thought to be lower than cost of residential equivalent.
Nigeria COSIT University of Lagos 1980-8	1984 730	1,145	2000	345 per full-time student equivalent 1,304 per graduate	If opportunity costs are omitted, then cost per graduate slightly lower than residential campus cost.
Uganda NITEP project 1993-7	1995 240	257	2,750	2,000 per successful student	Lower cost than equivalent.

Source: Adapted from Perraton (2000).

Note: The end date in column one refers to the period reported, not necessarily the end date of the project or programme.

The present discussion has primarily focused on people costs, that is, on the cost of teacher involvement and learner achievement – on human capacity overall. What about the costs of materials development, which is certainly not minimal, at least in the development stage? The USA has many examples of federally supported projects that have been funded by research dollars but which are then not fully, or even partially, commercialized to the broader public. Some programmes, such as *LiteracyLink* and *Professional Development Kit*, have fared somewhat better, as individual states in the USA have opted to support them and pay for them out of state-based funds. Others wither on the vine, as technologies move on, and much of what was done in older technologies is no long very useful in later years on different hardware/software platforms.

Table 5

Technology choice and costs from developing country perspective			
Technology	Prerequisites	Running costs	Location of expenditure
Radio	Broadcasting station with available airtime. FM stations offering new opportunities.	Typically 1/10 of TV	Mainly central. Reception costs for receivers and batteries.
Television	National TV service. Audience big enough to justify production costs.		
Cassettes	Modest studio facilities only.	Distribution costs likely to make cost uncompetitive with radio when audience > 500.	Mainly central.
DBS	Access to transponder, uplinks and downlink or specialist receiver.	As for broadcasting, apart from receiver cost.	Mainly central.
Distance education for teacher training	Organizational structure for materials development and student support.	Typically below cost of conventional education.	Central for materials. May be local for student support.
Teleconference	High technology at centre. Specialized equipment at satellites.	Likely to exceed conventional teaching where tutors are employed at each site.	Both central and at each satellite.
Computers in schools	Provision of hardware and software to schools; maintenance; staff training.	Probably exceeds cost of television.	Cost may fall mainly on school.
Computers in school with Internet access	As above, together with access to ISP and telephone lines.	As above, but with line charges added.	As above, but communication costs likely to be met locally.

Source: Adapted from Perraton (2000).

With respect to ICT, not only must important policy choices be made, but they must be made in a very timely fashion, if they are not to be rendered of lower value due to obsolescence. To make these choices is of course a central question. In Table 5 (Perraton, 2000), a review is provided on what specific ICTs are likely to offer, ranging from radio and television to computers in school, with and without internet access. Various factors and principles are described, and these must be borne in mind by any decision-maker who is contemplating purchases of ICT for education. Most striking are the contrasting choices that must be made simultaneously, thereby confirming what is known by most who buy technology – it is not very easy to make fully rational choices. It is no surprise, therefore, that ICT has become one of the most difficult decisions that educational policy-makers have to make today, often under conditions of considerable uncertainty about what really works best.

Technology in Support of a Broader Vision of Literacy

Another approach to the use of technology is to consider ICT in the broader context of economic and social development and examine the way technology is changing what it means to be a literate person. As discussed earlier, the welfare of both the economy and the society more generally depends on the creation, exchange and use of information – information that is increasingly in digital form. In this regard, a broader vision of literacy is needed, as acknowledged by the UN Literacy Decade Action Plan (UN, 2002*b*). As networked computers, wireless PDAs, video cameras and other information and communication technologies become integrated into everyday life, additional skills are needed to operate the technology and to use it to one's own benefit, as well as to the benefit of society. Beyond the traditional skills needed to read and write text, new skills are needed to use technology to: search for, organize and manage information; interpret and analyse data; work with distributed teams; communicate with others; and to use information to solve problems and create new knowledge and cultural artefacts. With these skills, citizens of today's world will be better prepared to search for, create and use information to extend their education, and to advance their economic, health and living conditions.

Further, literacy has come to be viewed by researchers more recently as not just a cognitive process but also a social process by which people in a community use spoken and written language to understand, communicate, and accomplish important tasks in their everyday lives at school, home, the workplace, and other social settings (Street, 1999*b*; Wagner, 1995, 2000). This broader notion of literacy fits the needs and reality of adult literacy learners and users better than the narrower notion of literacy as the cognitive processes of reading and writing text. It provides a purpose and value for literacy, comprising the skills and activities of a community that generates, shares and uses knowledge for the betterment of its members.

The previous section focused on ICTs as delivery tools that can support the acquisition and use of basic skills needed to read and write text. The current section adds these new ‘information skills’ to the definition of literacy; and it emphasizes ICT as a productive technology that can be used to communicate and create new knowledge, in a variety of forms, within a social context in which information and knowledge are used to solve problems, share cultural practices, and advance the welfare and economic development of a community. Clearly these may be seen, for the most part, as more ‘advanced’ literacy skills that build on the more basic skills of reading and writing. While this broader definition may seem to be largely theoretical and conceptual, it will be seen below that there are a number of important practical implications. And, while this definition may have the most immediate implications for the industrialized countries, the implications for developing countries are also significant (and not very far off in the future), as the latter formulate policies and programmes that jump-start the ‘high road’ approach to the technology–knowledge–economic development spiral, so as to benefit the economy, the society and its citizens.

4.1. CHANGING VISIONS OF LITERACY

At the intersection of technology and literacy, one must consider what is already part of mainstream and lay thinking. Notions of ‘computer literacy’, ‘technological literacy’ and ‘information literacy’ not only borrow terminology from text literacy but begin to redefine what ‘text’ is and the tools and skills that literate people need to use and create it (Murray, 2000; Tyner, 1998). But, it must be understood that the above terms do not necessarily connote the same thing in the present discussion. An important distinction in this presentation is between the skills that are specifically required to manage technology (for example, in ‘computer literacy’ this would be using a mouse, connecting to the internet, etc.), and those skills required to manage information, for example, how to organize, search and produce digital information. This is what we refer to as ‘information literacy’.

Information literacy and the use of digital information. Information literacy and text literacy have different implications for the skills needed to use, produce and share information. While text literacy

remains the foundation for information literacy, the convergence of text, sound and video in ICTs offers the reader/viewer information in multiple media. Information presented in additional (and sometimes redundant) forms may reduce the level of skill required to use information, and this can be particularly important for adult basic learners. However, the storage of, and instant access to, millions of digital documents on the web – and the unique navigational conventions of hypertext – require a different set of strategies to find, read and use these documents. As a consequence, information literacy has come to encompass a broader range of human competencies needed to access and manage information, analyse and interpret this information, critically evaluate its relevance and credibility, use the information to solve everyday problems, collaboratively create knowledge products, and communicate ideas in a variety of media for purposes valued by a community (21st Century Partnership, 2003; Committee on Informational Technology Literacy, 1999; ETS, 2002; ISTE, 1998; OECD/Statistics Canada, 2000; Quellmalz and Kozma, 2003).

Literacy, the internet, and the creation of digital products. As learners acquire and solidify basic literacy skills, these skills can be used to acquire the more advanced information literacy skills needed to be productive and successful in a knowledge economy and an information society that is increasingly influenced by technology. To participate in, and contribute to, these changes, learners must be able not only to access and manage the information of others, but also to produce their own digital, multimedia content.

The ability to use equipment such as computers, video cameras and recording equipment will become more important. But so will the skills needed to use authoring packages – that is, the set of software tools that can help users create multimedia or hypertext products that will appear on the web. Hypertexts are electronic documents that contain embedded links to yet other web pages, texts, images, sounds, definitions, examples, and so on. Common web-design packages help users create multimedia hypertext websites without the need to know a lower-level scripting language like Hypertext Markup Language (HTML). They make it relatively easy to format text and pictures, embed other media, and create navigational devices. To date, the educational use of these tools has been primarily the domain of vocational or technical education, where students are taught skills

that prepare them for jobs (Eisenberg and Johnson, 2002). However, training in their use can be of significant value for adult education programmes in developing countries that are trying to build their technological infrastructure and human capacities. But these tools that can be used to contribute new knowledge and cultural content for the web can also support the development of literacy as it is more broadly construed.

Literacy and networking. While word processors, web authoring packages, and other multimedia tools may support the creation of written products, other tools and approaches are needed to support the social processes of literacy. One application of the social processes approach uses the capabilities of networks and collaborative writing tools to support the interactions of groups of writers working together; the earliest of these was the ENFI (Electronic Networks for Interaction) project (Bruce et al., 1993). In this project, writing instructors had students use a suite of writing tools and communication software to share their writing online at various stages and discuss it with other members of the class, who served, along with the teacher, as an audience and guides. The project supported the social aspects of writing by involving the writer in discussions (electronic rather than oral) with other members of a community focused on literacy activities, and by making the writing process open to public observation and discussion.

Scardamalia and Bereiter (1999) extend the use of network-based software environments to support what they call 'knowledge building communities'. The assumption of this approach is that a community is based in part on knowledge that its members jointly create and share, and in part on the interactions among members as they engage in knowledge creation and use. Scardamalia and Bereiter developed networked software that allowed students to work together online to build and share a digital, multimedia knowledge-base on a topic of mutual interest and for a common purpose.

The effect of these information-rich environments is to build and support a literate community and to enlist the resources of that community to support the creation of knowledge and knowledge products that advance the purposes of the community and its members. This way of defining information literacy, using new ICTs and multiple media as part of everyday social practice, is in greater synchrony

with the needs of the knowledge economy and information society (European Commission, 2000; OECD, 1996, 1999). Thus, there are new skills and tools that must be acquired to support information literacy acquisition.

While these new information literacy skills are becoming increasingly important to society, they are not yet commonly taught as part of formal schooling or non-formal literacy programmes. In a recent AOL Time Warner Foundation-sponsored national survey (<http://aoltimewarnerfoundation.org>) related to their 21st Century Skills Partnership, 92% of respondents thought that young people need different skills today than they did ten to twenty years ago, and 91% said it is 'very' or 'somewhat' important to prepare young people with twenty-first-century (information) literacy skills. And while 74% of US respondents thought that teens are learning basic skills, and 60% thought they are being taught to use technology effectively, only 48% believed teens are learning communication skills; 37% thought that teens are getting critical thinking and decision-making skills, and only 28% believed young people are learning how to make a difference in their community.

4.2. INFORMATION LITERACY AND NEW APPROACHES TO LEARNING AND TEACHING

Information literacy relies on and supports new approaches to curriculum, learning and teaching. An educational goal that values the collaborative creation and use of knowledge conflicts in a fundamental way with approaches to teaching and learning that emphasize only the authoritative role of teachers and textbooks and the rote memorization of facts and procedures. New approaches to learning and teaching emphasize not only the importance of established knowledge in the curriculum, but also the primary responsibility of students for their own learning, the importance of group and community in supporting the learning process, and the role of assessment in providing ongoing information that students, teachers and others can use to monitor progress and measure success (Bransford et al., 2000).

In a recent review, Nunes and Gaibel (2002) provide a useful schema for thinking about the connections between ICT and such new approaches to learning and teaching. Their schema is adapted here as follows:

- Learner centred. Increasingly, ICT environments will be sensitive to specific and diverse learner needs. Information will be customized to the interests of the learner, presented in appropriate modalities, addressing his or her specific educational goals, and building on his or her everyday experiences and cultural and linguistic strengths. Furthermore, students will be able to direct their own learning. As they become more knowledgeable and their literacy skills increase, they can use technology to design their own learning plans and create their own knowledge products.
- Knowledge centred. Sophisticated tutorial environments will support students in their mastery of knowledge and skills in specific subject domains, including literacy. Rather than merely cover or include a wide range of topics, technology will be used to help students to accomplish important specific learning standards, interconnect and integrate what they learn, develop a deep understanding, and use this as a base to learn more. This level of mastery is particularly important in the acquisition of literacy skills, as students need a strong foundation in basic skills to develop more advanced literacy skills needed for the twenty-first century.
- Assessment centred. Technology will actively assess students' learning throughout the educational process, not just at the end of a course or school year. Software will provide regular feedback to the learner so that the learner, if working alone, can gain sufficient insight as to what may be best learned next. Sophisticated software, such as artificial intelligence, will allow for the assessment of increasingly complex skills and deeper understanding. Technology will be used to show the progress of students' understanding and the increasing sophistication of their products. The software will also provide the instructor and/or the programme director with useful information on the status of learning achievement of the individual learner or group of learners.
- Community centred. Context – particularly social context – is important to the success of learning. Literacy programmes will

be more successful when students are learning in an environment where these skills are valued by other students and the community more generally. This will happen when it is clear that these skills can be used to accomplish other social and economic goals that are also valued. With the appropriate skills, students can use ICT tools and resources, access information, and produce products that can solve locally important problems related to health, family care, or economic success. It can also be used to give students an awareness of their place in the broader world around them, at the village, regional, national and global levels.

Several recent international studies (Pelgrum and Anderson, 1999; Kozma, 2003*a*, 2003*b*) have documented the fact that schools and classrooms around the world are beginning to implement these information literacy approaches to teaching, learning, and the use of ICT. Case studies of innovative schools in twenty-eight countries in North and South America, Europe, Asia and Africa found important similarities in how teaching and learning is changing and how ICT supports these changes (Kozma 2003*a*, 2003*b*). The study found that, in a large majority of these innovative classrooms, teachers were engaged in advising and guiding their students' work, along with more traditional practices such as creating structure and monitoring or assessing student performance. Students used productivity tools, web resources, email, and multimedia software, and collaborated with each other to search for information, publish or present the results of their projects or research, or design or create various digital products. As a result, teachers claimed that students acquired ICT skills, developed positive attitudes toward learning or school, acquired new subject matter knowledge, or acquired collaborative skills.

4.3. SOCIAL STRUCTURES AND INFORMATION LITERACY IN DEVELOPING COUNTRIES

Information literacy activities occur with great variation across cultures in both industrialized and developing nations, but it is clear that they are most often associated with formal schooling, where such information-based knowledge products have substantial inherent value. However, these processes, purposes and contexts – and the technolo-

gies that support them – may seem quite far removed from the lives of youth and adult learners in developing countries. This seeming contrast is likely more apparent than real. Indeed, the use of technology to support adult literacy and learning, in developing countries, may require especially those kinds of skills that are described above, and these may be the most efficient route to improving literacy in poor countries. As counter-intuitive as it may seem at first glance, it is our contention that *only by using ICTs will the promotion of adult literacy succeed* in making substantial inroads in the consistently dismal world statistics. More importantly, only by using ICTs will we be preparing low-literate adults for a future that will increasingly require the kinds of flexible skill sets that are needed in a competitive, global economy and a society increasingly influenced by ICT. Even so, the use of ICT to advance literacy in LDCs presents significant challenges and will require novel social structures that go beyond the classroom and into the community.

Social construction of literacy. There are various theories regarding origins in literacy theory and practice that suggest that literacy is not simply a set of skills that are learned independent of society. The literature on this domain is vast, ranging from Freire and Macedo (1987) in Brazil, Wagner in Morocco (1993), to Peck et al. (1995) in the USA, to the work of Barton and Hamilton (1998) in the UK. This notion of *community literacy* is important in a number of ways, in both industrialized and developing countries. Within this framework, everyday literate practices in the community are *transactions* or discourse (and, in this way, more like speech than text), inherently collaborative, and action-oriented, and understood in the relationships between actors who are part of the literacy transaction (e.g. accountants and clients in the US; or rural scribes in Morocco). Using literacy to solve problems in everyday life is more important than each individual generating new school-like texts, as has been suggested most clearly in the ‘real literacies’ approach used in several LDCs (Rogers, 1999); the more general notion of ‘literacies’ has been the subject of increasing interest in the development field (Wagner, 2004).

From this point of view, reading, writing, and knowledge production become inseparable from *purposeful* literacy transactions with and between specialists, allies, stakeholders, co-workers, family members and neighbours. For those with poor skill-levels, these literacy transac-

tions can help them to cope with poverty, get a job, recruit resources, or improve the community more generally. These activities, then, are part of a goal of creating products – a joint document, a resolution, a shared problem definition, memorandum of understanding, or collaborative plan of action in service of locally defined and determined purposes. Further, such literacy-knowledge products that emerge out of poor communities can serve to improve the conditions of people in any society. How this is accomplished and built upon within the broader vision of technology has been the subject of a number of important efforts in recent years, as described below.

Community Technology Centres. Probably the best-known example of how community literacy and technology come together has been the emergence of community technology centres (CTCs) or ‘telecentres’. CTCs can be an important strategy by which LDCs can address the significant resource and logistical issues that they face when introducing ICT into adult education. But, more importantly, they can also be a means by which educational uses of ICT can be integrated into the broader needs and social interactions of the community.

In the USA, the development of these centres has been encouraged by federal support for the Community Technology Centers programme (US Department of Housing and Urban Development, 1999; Michalchik and Penuel, 2003). The programme uses CTCs to increase access to technology and to promote the use of technology in education in urban and rural areas and economically distressed communities. These centres also provide training related to the use of hardware, software and the internet, as well as other services. The programmatic focus differs from centre to centre and ranges from providing after-school academic support to children and improved home–school connections on the one hand, to providing technical training in ICT skills to unemployed labourers and adult literacy and English-language skills in ethnically diverse neighbourhoods, on the other.

In LDCs, telecentres have also received a great deal of attention, particularly as a way of providing greater technology access, with the broader goal of increasing economic development (Proenza et al., 2001). These CTCs tend to have a broader range in structure and programmatic focus than American CTCs. Some may be private, commercial centres, sustainable by ‘user fees’; others may be sponsored

by a university, school, NGO or municipality. Commercial centres, such as internet cafes, may not have a specific programmatic focus but rather are open to the public. University-sponsored centres may be connected to social outreach programmes or off-campus course offerings. School-sponsored centres may share computer labs (used during the day for classes) with parents and other community members in the evenings. An example of the latter is the *Enlaces* network in Chile (Hepp and Laval, 2003) where computers have been put in 100% of the nation's secondary schools and more than 50% of the primary schools. The programme provides schools with computer labs, community access to technology, access to an education portal on the internet or to CDs with similar content, and training in the use of technology. The *E-Learning for Life* (ELFL) programme in Malaysia is another example, bringing e-learning opportunities, training and access to more than 10,000 students, as well as their teachers and local communities. A similar CTC programme has been set up in El Salvador (see Box 9). New and mixed-use ICT telecentres are also finding their way in development, such as in the wireless programme in the Dominican Republic (see Box 10), and the combined ICT model in Sri Lanka (see Box 11).

The growing phenomena of CTCs can be combined with the notion of community literacy to make these two developments even more powerful, particularly for developing countries. Access to computers and the internet provided by CTCs can be combined with training in

Box 9

Telecentres in El Salvador

The *Infocentros* Telecentre model in El Salvador is an ambitious effort to promote the rapid spread of information technology in the developing world. Its emphasis is on building demand for computer and internet access. With a goal of bringing access to a third of the total national population (roughly 2 million), particularly those in the lower- and middle-income bracket, its potential promise lies in its business-oriented strategy. *Infocentros* itself is a non-profit franchise through which small investors can open for-profit internet cafes, which requires little capital relative to an independent venture. Being a franchise with a target of 100 telecentres in three years, *Infocentros* is able to obtain wholesale prices for hardware, software and bandwidth, all of which remain expensive in the country. Their holistic strategy includes community-based content, exemplary customer service, and marketing campaigns designed to drive demand. The staff is trained to offer one-on-one assistance to customers who are unfamiliar with the technology, and this helps in attracting new users since many feel intimidated by the centres.

[Source: http://www.digitaldividend.org/action_agenda/action_agenda_01_infocentros.htm]

Box 10

Wireless internet access in Dominican Republic

This project is made possible by a collaborative effort between Cornell University graduate students, Ecopartners and ADESJO, both NGOs. Computers were brought into El Limon, an isolated rural community in the Dominican Republic, initially for email and other programme administration purposes. Connectivity was established through use of spread spectrum digital radio, which connects to a phone line in another town several miles away. The initial curiosity among village residents grew into intense interest in how this new resource can be used to improve their lives. More computers were eventually brought in, making El Limon one of the first isolated communities in the country to have public internet access. Farmers go online to look for information about agricultural practices, students to research information for their schoolwork, provide additional resources for their teachers, and chat with acquaintances from other areas. There are now plans to offer computer training classes for residents in neighbouring towns, a profit-generating activity that is hoped to increase the likelihood of sustainability. Three additional identical projects are underway in Jarabacoa, Il Fantino, and Los Frios de San Juan. All of the facilities are to be housed within the high school or primary school and will provide shared internet access for the whole community around it. Aside from teaching residents computer skills, their major goals include providing much-needed email or local Voice over Internet Protocol (VoIP), which would circumvent the scarcity of wireline connections in rural areas.

[Source: <http://www.sas.cornell.edu/cresp/ecopartners/comp/NetCur.htm>]

Box 11

A mix of ICTs in Sri Lanka

The Kothmale internet project was established in 1998 through a partnership between UNESCO and local agencies in Sri Lanka. It focused on several elements they considered to be crucial for ICTs in a rural context: community awareness, skills capacity, public access and locally appropriate content. Planners took advantage of an existing community radio station, which they supplied with three computers, a dedicated 64 Kbps microwave connection, and a server computer. The benefit of using a radio station to head the initiative is that it functions as a highly specialized and focused marketing tool. They began to air a regular programme that features 'radio web browsing', where commentators talk about information gathered from the internet and deemed useful for the local community (e.g. health, legal issues, weather, wholesale agriculture prices). They also discuss what the internet is, the fact that it contains massive amounts of useful information and offers many benefits even to farmers and labourers. This raises awareness about the uses and benefits of information, as well as minimizing the intimidation some may feel regarding the technology, which in turn generates interest in learning how to search the internet. Testimonials offer interesting insights; the local baker learns new recipes, the blacksmith and bamboo artisan learns new craft techniques, the community identifies an export marketing opportunity for a local product, and the tea farmer learns how to process his product more efficiently. The project deals with content issues by providing personalized assistance to users (i.e. surfing, translating, etc.) and maintains a website (www.kothmale.net) with locally generated content.

[Source: http://www.unesco.org/webworld/netaid/com/sri_lanka.html]

ICT skills, such as accessing and managing information and creating multimedia, digital products. These, in turn, can be used for high-value social purposes, such as preserving cultural practices, coping with poverty, getting jobs, recruiting resources, or improving the conditions of the community. CTCs can be used to provide community members not only with access to the internet, but also access to specially designed, government-supported portals that have linguistically and culturally appropriate, highly relevant content related to health, nutrition, family planning, continuing education, employment and agriculture – information that people with new literacy skills could

Box 12

Tribal digital village in California

More than 7,600 American Indians live on reservations in isolated and scattered rural communities stretching from the Mexican border into Riverside County, California. Nearly 30% of the tribal community's population lives below the poverty line, and 50% are unemployed. They do not have the means to regularly connect with each other or to the rest of the world. Recent federal reports have shown that rural Americans and tribal areas will lag behind others in gaining access to advanced telecommunications services if deployment is left to market forces alone. The goal of Hewlett Packard's Tribal Digital Village is to connect the eighteen American Indian reservations in San Diego and southern Riverside counties to a high-speed internet backbone and use the internet to build communities of interest among tribal members, in ways that resemble family and community networks. The goal is to create a distributed digital community that mirrors and amplifies the community and kinship networks that have historically sustained these tribal communities. The Tribal Digital Village plans to use new technologies to enable community initiatives, partnerships and programmes in the following areas:

- Technology: create an internet backbone and high-bandwidth connection that will link all of the reservations to the internet.
- Culture: maintain and express tradition, link urban dwellers to community events at home, develop language websites
- Education: drive cultural re-education for native people including culture, history and language, tutoring and mentoring
- Community: encourage sharing through email, web cams, interactive tribal calendars, GIS sacred sites
- Economic: develop business incubators; career networks; job training, searching, posting; selling tribal arts online

A new community portal (www.sctdv.net) allows each village to create a presence on the Web. The Tribal Digital Village has planned for sustainability by involving community youth and adults in the execution of the project. For example, a team of Native Americans is working on setting up the network infrastructure for the project by using topographic software to identify sites and setting up solar-powered high-speed wireless network nodes.

[Adapted from <http://grants.hp.com/us/digitalvillage/tribal/vision.html>]

use to improve their lives. They can use such CTCs to represent the local culture to the rest of the world and to enlist global resources for local ends. Programmes such as the Tribal Digital Village in Native American Communities in California (see Box 12) show how these resources and skills can contribute to such advancement.

While some CTCs are generally open to the public, others may try to target key populations. An example of this approach may be seen in the *Bridges to the Future Initiative* (BFI), which is designed to provide basic and information literacy skills for the poorest of the poor, including minorities, indigenous-language speakers and the unschooled (www.bridgestothefuture.org). There are three components to the BFI: (1) development of community learning and technology centres for lifelong learning, basic and ICT skill acquisition, and high-impact information resources in local languages; (2) development of ICT-based tools to improve teacher training; and (3) development of innovative ICT applications for human development and sustainability. Initiated by the International Literacy Institute, the BFI has active programmes in India, South Africa and Ghana. In the Indian state of Andhra Pradesh, for example, the BFI has thirteen dual-purpose community learning and technology centres, mainly located in secondary schools to save on ICT costs. These centres, which are open after regular school hours, have begun to provide Telugu language resources for helping children and youth get back into school, literacy and life-skills instruction for out-of-school youth and adults, and e-government resources that are both online and off-line. Teacher training materials will be developed soon. In collaboration with other partners, the programme is providing culturally and linguistically appropriate learning resources for illiterate and low-literate youth and adults (Wagner, 2001).

4.4. SOME EMERGING CONCERNS ABOUT ICT AND DEVELOPMENT

No area of education and development – especially one as new as ICT-based investments – is without its problems. What is perhaps most striking, as has been noted by many, is the paucity of research on the effectiveness of ICTs for learning achievement, whether in children or adults, whether in industrialized or developing nations. Part of this dearth is due, it seems, to the confluence of two factors:

(1) the essential attractiveness of ICT to the parents and community (including the business community seeking skilled labour); coupled with (2) the rapid changes in both software and hardware products, which make it very difficult (and often impossible) to track changes over time. And, as with literacy, learning achievement is not the only factor that needs to be considered. If, for example, a CTC is supposed to foster community and economic development, what evidence do we have that this has happened?

Recently, the Ford Foundation sponsored a report on just this issue, focused on CTCs and community development in the USA (Davies et al., 2003). While there were numerous positive outcomes mentioned, one remark seemed to capture the essence of the difficulties faced by CTCs:

Many CTCs are doing community-building work, but they don't have the language, or the vocabulary, to call it that ... For example, they are using technology for youth development because they are trying to keep kids off the street, get them back in school, etc. Or they are using it as an early intervention strategy for young kids. Or for helping seniors ... There are disconnections between the two fields if you define community-building narrowly. (cited in Davies et al., 2003, p. 22)

Quite likely, the same could be said about the CTCs and literacy development. The above citation does not suggest that CTCs cannot play a positive role in community building or literacy development. Rather, the human-capacity building and professional development of those in charge are often playing 'catch up' to the installed technology, which is the easiest part of the development process. If CTCs are to be used to actively promote community literacy, it is more likely that they will be successful if this becomes an explicit part of their mission, they are equipped for this purpose, and their staff is adequately trained in both technology services and literacy training. Indeed, as described in a very useful review of ICT and development in LDCs, the UNDP (2001) listed a set of principles for ICT investment that could well be adopted in any nation for any purpose (see Box 13). While very general in nature, the issues of focusing on learner demands and needs, and of sustainability, are ones that have been an important focus of the present book. Best and Maclay (2002) provide a more specific set of

recommendations for improving CTCs in developing nations. As may be seen in the various ‘boxes’ in this book, there is ample evidence that the use of ICTs in education and literacy is perceived by many users and implementers as a major success; it is the hard empirical evidence that seems difficult to pull together.

Box 13

Minimum requirements for ICT and development projects

1. Initiatives should be explicit about their development goals and how they will directly impact the target population.
2. Initiatives should be driven by user demands, identified and realized through direct participation and ownership.
3. ICT solutions should be ‘built to last.’
4. Initiatives should be sensitive to local conditions and limitations.
5. The interests of key stakeholders must be broadly aligned with each other and with the goals of the intervention.
6. Initiatives with the most impact have approached development problems in holistic and coordinated ways, not only through the provision of ICT.

[Source: UNDP et al. [2001].]

The use of community technology centres can be an important way to address the issue. One good example is the notion of a ‘digital divide’ in less developed countries. Many people have viewed the resolution of this problem as one of providing hardware or internet connectivity to those people who do not have it. Yet, what is often obscured, especially in LDCs, is that the large majority of ICT resources are going into the better-off half of the population (such as in secondary schools), precisely those groups that are *already* ahead of the general population. Of course, one can argue that any new ICT is better than none, but there is a serious problem of attaining EFA goals with this approach, and this will redound to the UN Literacy Decade as well unless special care is taken to support ICTs that indeed favour the poor. A recent review on software development in Africa (James et al., 2003) supports this point by showing just how little software content is available in local African languages, the languages of the poor. One major problem is that the claims of the ‘technology revolution’ have had the effect of raising expectations that many ICT-based education and literacy programmes cannot meet. More frustrating perhaps is the tendency of some of the purveyors of ‘ICT solutions’ (often with a commercial interest in mind) to ‘sell’ products (software or hardware)

that cannot meet the stated needs. Further, there is a problem with ‘truth in advertising’ in the broad field of ICT and development. By supporting the development of CTCs and providing disadvantaged communities with the technological and human resources they need to develop and share local content to address local problems in the local language, LDCs and their donors can go a long way to address the digital divide in poor communities.

Challenges for the Future

The development of new technologies provides policy-makers with significant resources that can be used to address the literacy needs of adults and to advance social and economic development goals. However, these new resources also present policy-makers and donors with significant challenges, particularly in developing countries. Fortunately, a number of policy studies and projects in both developed and developing countries provide help for both policy-makers and donors (Wagner, 2000; World Bank, 2002; Jones, 2003; Kozma, 2003c; Pont, 2004; UNESCO, 2004)

In this section, we review five types of investments and four policy recommendations that can guide the thinking of policy-makers and donors as they consider ways to implement ICT in adult education and literacy. While each country will need to make priority decisions within the context of limited resources, it will not be effective to merely pick and choose from these investment and policy recommendations. The issues we discuss are interconnected, and ignoring one policy area or another increases the likelihood that a programme will fail. The challenge for policy-makers is to craft the right balance of interconnected, phased, and prioritized investments and policies that are responsive to the particular mix of needs, history, resources and opportunities within their country.

5.1. ICT AND LITERACY: FIVE AREAS OF INVESTMENT

There are many types of investment that can be made in any educational endeavour. And, when literacy and technology are mentioned in the same context, one still hears some policy-makers say that the literacy education domain is so desperately poor that technology would be a 'luxury' that cannot be afforded. We hope we have dispelled the notion that ICT is too expensive or that there is too little relevant

experience to justify reasonable investments. One way to consider the investment question is to try to consider the specific areas where such investments are likely to make a difference. We suggest the following five areas.

Adult education and literacy. Policy-makers have serious challenges in deciding where to invest scarce resources. This is always an issue of prioritization. As noted earlier, literacy – especially adult literacy and adult education – have nearly always received lower priority and fewer resources than has K-12 education (Wagner, 2000). To turn this situation around will require not just a declaration such as the UN Literacy Decade (though this will help only in some countries), but rather a realization that adult literacy is a key part of the *whole* education system. When youth remain un- or under-educated and become unemployed parents who will have children who will likely drop out of school, one can see the potential impact of literacy (and the values associated with literacy) in terms of real and direct consequences on society and the economy. No decision-maker ever has enough resources for all that needs to be done. But the 20:1 funding ratio of formal schooling to non-formal literacy/adult education is simply too large a disparity, and one that will likely have a lasting negative impact. This ratio – like the literacy gap itself – must be narrowed and lifelong learning supported. Basic literacy skills are the foundation for further information literacy and participation in the knowledge economy and information society.

Infrastructure and access to technology. We believe that a substantive case has been made in support of the use of ICT in adult education and literacy. The *sine qua non* of technology use is access to equipment. Yet investment within this domain, especially from a developing country perspective where resources are in short supply, is difficult for policy-makers. The financial and political pressures on where to put hardware and internet access can be significant. Further, there is the omnipresent tendency to put such resources into the hands of those who can both secure its safety and ensure its immediate use – each of these factors tends to push decision-makers to support investment in already well-endowed schools in (usually) urban areas. Thus, the UN Literacy Decade provides an opportunity for policy-makers to state clearly that their objectives include a major focus on poor, illiterate

and low-literate populations, and that this priority extends as well to the ICT domain. Such a policy was adopted by the Government of South Africa, which produced a governmental white paper in support of combining the efforts of the IT and Education ministries to work together to improve literacy and adult education.

We believe in the importance of a mixed portfolio of investments that would include various traditional technologies – such as radio and television – as well as computers and networking. New resources should build on and strategically extend current infrastructure and technological expertise, and they should be carefully designed to meet programmatic goals. Low-speed dial-up telephone access or one-way high-speed access, such as satellite transmission, are often initial strategies to buy into internet access, particularly in remote areas. However, the ability to generate knowledge products and fully participate in the knowledge economy often requires high-speed two-way access to the internet, as well as access to digital cameras, video and audio recording equipment, and computers with sufficient speed and memory capacity. Resources should also include various software tools, such as productivity tools and authoring systems.

Both limited resources and wise utilization argue for a phased implementation of new technologies. This carefully planned deployment of equipment and network solutions should fit into the scheduled development of other resources, such as the training of technical staff, the professional development of teachers, and the development of curriculum content. Pilot projects are often useful in identifying issues and solving problems early on. But as mentioned above, these pilot projects should include disadvantaged communities and not merely capitalize the further development of well-endowed schools and communities.

Community technology centres. CTCs are a particularly strategic investment because these centres address both resource and programmatic needs. CTCs are often a relatively low-cost means to provide a range of community constituencies with their initial access to computer equipment, software and the internet. This single investment in a community can provide initial access to small businesses, social services and educators. Because they are often located in schools, they can serve the needs of primary and secondary students and teachers during the day and adults and out-of-school youth in the evening. This initial

relationship can also serve as the hub for other connections across the community, as the demand builds for these resources.

CTCs not only provide equipment and networking resources to provide access to wide segments of the community, but they leverage these resource by connecting them to services that benefit from, and give a meaningful context for, the use of ICT. CTCs programmes often include two or more of the following services: training in computer operation and software use, training in networking management, basic literacy, adult education, business development, and/or community or health services. Technology and digital resources can help staff provide high quality educational and community services. At the same time, by introducing computers in these contexts, CTCs allow users to immediately apply their new technical skills for their own educational, economic and personal benefit.

Professional development for teachers and others. The professional development of administrators, directors, teachers and tutors is an ongoing and critical process for educational improvement. This is particularly so for those engaged in adult education programmes, which often rely on volunteers; in such programmes the tenure of the typical tutor/instructor is often too short to assure quality improvement. Since most countries (rich and poor) invest an extremely small fraction of available education resources in the non-formal sectors of adult education (relative to the formal school system), there is a compelling case for bringing the matter of professionalization to the attention of policy-makers. A mixture of traditional and new ICTs can be an important way to provide teachers with professional development services at a distance, and investments in this area can have significant payoffs. Not only can ICT provide direct instruction to teachers through online materials, network connections can provide teachers with online communities of other teachers who can provide advice, share resources and build professional knowledge.

The use of ICT will, of course, require the development of technical skills among teachers and the development of a human infrastructure for technical support. Teachers not only need to learn how to operate computers and master common software tools, they need to learn how to integrate ICT into their curriculum. It is also very important to provide teachers and teacher trainers with up-to-date instructional methods. As mentioned earlier, the development of information lit-

eracy skills that enable participation in the knowledge economy and information society requires new approaches to teaching and learning that shifts the role of the teacher and emphasizes active student engagement in the use of ICT to find, organize and apply digital information to create knowledge products.

Development and aggregation of highly useful content. In multiple instances throughout this book, the paucity of cultural and linguistic digital content has been cited as a serious problem in many developing countries. A significant investment is required to provide such digital content (on the web or in other media) as would be most useful for poor people. This content could and should address important local needs related to health, nutrition, family planning, continuing education, employment, agricultural production, and so forth – information that people with new literacy skills could use to improve their lives. This information could be combined with existing content and organized within portals specifically designed to make the information easy to access and use by targeted user groups. As discussed above, digital content has a number of significant efficiencies relative to the production and distribution of text. The production and distribution costs can be lower with digital media than print media, once the initial infrastructure is in place, particularly when the need to update information is considered. The ‘anytime’ access capability of digital web content has a distinct advantage over broadcast information. Furthermore with minimal additional investment, existing print and recorded content can be incorporated into the multimedia, digital information base. The cost of production can be further reduced as the population becomes more information literate and begins to generate its own content, which can be added to this shared resource.

There are several promising avenues for promoting the design and development of instructional content in LDCs. First, institutions of higher education that train teachers (e.g. universities, colleges and institutes) could become more involved in literacy and basic education work, and provide up-to-date professional and instructional-design training to teachers in these fields; some of this may be seen in James’ (2003) review on African software development. Second, institutions which are already well positioned in the area of internet access should become the loci for both receiving and disseminating information that could assist in building the local and regional knowledge base. Each of

these is an area in need of further support from donor agencies. Finally, and more generally, much more is known about reading acquisition in youth and adults than heretofore (as described in Section 3 above). Putting these new theories to work in helping to design instruction would be a major step forward in developing multimedia software that is effective for diverse learners.

5.2. IMPLICATIONS FOR POLICY

Policy-makers have a number of difficult decisions to make with respect to supporting the use of technology to improve literacy work. These general principles can help guide the policy-making process in this regard:

Policy leadership. Policy leadership will be the key to any successful effort to introduce ICT into literacy and adult education, particularly if these efforts are to contribute to economic and social development. Projects and programmes offered outside of a policy context will fail in the long run. Many countries (Singapore, Finland, Chile and the USA, to name a few) have developed ICT national plans to provide a policy context that guides new technology-based programmes and projects. These national plans articulate a vision for how ICT can contribute to education reform and improvement. The vision may tie the introduction of ICT to economic development (as is the case in Singapore), social development (as in Finland), or some other national priority. These plans also authorize specific projects and programmes to advance such visions and provide the resources needed to implement them. If no such national plan exists in a country, we recommend that one be established as a first step toward an effective and sustained effort to use the potential of ICT to improve education. If such a plan currently exists, it is likely to emphasize primary and secondary education and not include or focus on adult education or lifelong learning. We recommend that adult education, lifelong learning, and literacy – particularly the broader definition of literacy as described herein – be an important theme in any new or revised ICT national plan.

Policy coordination. To maximize the impact of ICT investments, ICT-related policies in education must be coordinated with other reforms

and changes in education. The mere introduction of technology, no matter how advanced, will not result in educational improvement or reform. Indeed, without other, parallel education reform policies, the introduction of ICT is likely to have only a marginal effect. In some countries, the introduction of ICT is a response to policy changes in curriculum, pedagogy, teacher training, and assessment. However, the impact of ICT will be greater – particularly if the goal is to advance information literacy and contribute to the knowledge economy – if its introduction is linked to a curriculum that emphasizes ICT use for knowledge creation, along with a pedagogy that emphasizes student engagement, teacher training and student assessments that focus on knowledge use, as well as recall of facts and procedures. It is essential that adult literacy and basic education policies be coordinated with those in primary and secondary education.

Furthermore, the impact of ICT use in education can only be fully realized if educational policies and programmes are coordinated with those in other ministries, such as telecommunications, economic development, human resource development, health, agriculture, rural and urban development, and so forth. In this manner, telecommunications policies can increase network availability for schools and community centres. Economic and human resource development policies can support adult literacy and basic education and the use of ICT for vocational training. Health and agricultural policies and programmes can provide digital content that can improve health literacy and healthy behaviours. And urban and rural development policies and programmes can promote the use of community technology centres as a way of improving skills and providing technology access to disadvantaged communities. A national, inter-ministerial ICT coordinating agency or council could facilitate both policy and programmatic coherence, as well as promote the sharing of resources.

There is considerable potential for helping learners and communities resolve their own issues more efficaciously if ministries could break down some of the barriers that separate activities and agencies. To cite just one example: in the BFI project mentioned earlier, the health and the education authorities in India and South Africa, with support from the World Bank and others, are working to provide both literacy instruction and hygiene information on a single multimedia location for low-literate youth and adults. Individual learners will not have to go to a separate literacy class and a separate health-education

class in order for this information to be effective. It is hoped that this type of programme will save both time and the resources of the government as well as of the individual learner.

Private–public partnerships. The approach proposed here requires a significant shift in priorities and resources. This shift is particularly challenging for poor countries. However, it is LDCs that potentially have the greatest to gain with this shift, because the intent of these proposals is to use ICT and adult literacy education to take the high-road approach to economic development and join the knowledge economy and information society. Yet it is clear that the greatest investments within LDCs will come from the private sector, particularly the technology industry. Several large multinational technology companies have provided technology training for teachers or training of students as network administrators. To the extent that national policies can be articulated with, and support, these investments, they can be leveraged to enhance the strategic development of infrastructure and adult education, rather than merely the business strategies of private enterprises.

Outcome-oriented policies, programmes, and evaluations. The significant investments required of the approach that we advocate require a significant return in terms of adult learners served and the number of learners who become literate and productive workers and citizens. While policies may offer sweeping visions for how technology can advance economic and social development, they should also describe how these visions translate into measurable goals. Programmes should not only provide resources intended to realize policy visions but focus on specific, phased and measurable outcomes. New policies and programmes may require the development of new benchmarks and assessments that measure a different set of goals and outcomes than those of previous policies. Measures that focus on the ability of learners to search for, organize and use information resources to create knowledge products are different than those that focus on the recall of factual information or procedures. Both process and outcome measures should be used to monitor the progress of policies and programmes and provide information to policy-makers that can be used to revise and refine policies and programmes.

5.3. THE ‘LAST MILE’ VS THE ‘LAST FEW INCHES’: ACCESS VS LEARNING REVISITED

It is commonly said that ICTs ‘fail’ when they reach the ‘last mile’ of connection with the target population. What is usually meant, in Africa for example, is that it is much easier to put power lines or telephone lines near a village than to get them into the village in terms of effective use. As we move into the twenty-first century, this situation has now become even more complicated; as discussed earlier, skill standards have increased such that a broader vision of literacy is now becoming apparent in many countries. It is no longer sufficient, for example, to have the power or telephone grid – or even the PC or internet access – inside a village, even though these are necessary components of most ICT and development projects. Rather, it is the ‘last few inches’ of the cranium that has to now be attended to. Installing PCs into a classroom has little overall merit if the software is in the wrong language or is of little interest to the learner. It is surprising perhaps, but still true, that many projects end at the installation of ‘plain vanilla’ PC-based installations into schools or CTCs. As noted in the previous section, such programmes in this century are doomed to fail either in the near term or in the long term. The ‘last few inches’ of learning in the individual needs to be given more consideration in the planning and evaluation process, especially when one is working with the most difficult to reach and to teach – namely those that are unschooled, poorly schooled or out-of-school. The bottom line is that those ICT-based programmes that do not pay sufficient attention to the learning, cultural and attitudinal needs of the individual are likely candidates for failure in the near term and lack of sustainability in the longer term.

Conclusions

The UN Literacy Decade has only just begun. Its success will depend on the mobilization of the best talents that can be brought to bear on worldwide literacy problems. The use – indeed the increased use – of effective and appropriate technologies can play a significant role in creating a more literate world. Conversely, the failure to take appropriate advantage of ICTs to help improve the lives of the poorest and least-schooled populations of the world make it all the more difficult to achieve the goals of the UN Decade, as well as the complementary goals of the EFA and the Millennium Development Goals initiatives.

At the same time, if the present book is correct, it is essential to understand that neither more hardware nor more connectivity alone will positively impact the lives of poor people. At the policy level, without specific directives to the contrary, most ICT resources will end up where they are least likely to be effective for poor people. At the professional level, human resources (whether in content or in ICT design), as well as teacher training, remain heavily weighted towards the formal K-12 sector, where the vast majority of national budgets reside. This will need to change if literacy is to be increased. Furthermore, literacy and technology are becoming interdependent, as we have shown in Sections 3 and 4. Literacy and technology are ‘tools’ that have much in common. Neither is an end unto itself, but each can amplify human intelligence and human capability. Literacy education will need to take advantage of the power of technology, and work will require an ever more skilled population of producers and consumers.

In this book, the main focus has been on literacy for the poor and underserved. But, as statistics indicate worldwide, there are rather substantial differences between what ‘being poor’ means and represents in different countries, and even within the poorest LDCs. As noted, there are ICT digital divide programmes that can widen the divide, by

investing in the top end (easier to reach) parts of the spectrum of the disadvantaged population. Thus, it is suggested here that if the UN Decade is to succeed, it must also try to reach the unreached, to reach those at the bottom end of the literacy divide, and to pay attention to how ICTs can make a special contribution.

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