CHAPTER 30

New Technologies for Adult Literacy and International Development[1]

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[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 DOT, 2001, p. 10

Literacy is a human right.

Kofi Annan, 2003

Literacy and International Development

Few areas of social and economic development have received as much attention and as few proportionate resources as adult literacy. Across the world – in both industrialized and developing countries alike – it is widely acknowledged that at most, 5 percent of national education budgets is spent on the roughly 50 percent of the adult 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, Venezky & Street, 1999; also UNESCO, 2005), in that literacy 'campaigns,' in particular, were often more politically inspired than practically implemented (Wagner, 1986). 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 significant toil and funding have led to only limited return on investment.

Thus, as we near the halfway point of the United Nations (UN) Literacy Decade (declared initially in February 2003), one might legitimately ask what progress have

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we made and how far will the Decade take us? 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? 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. In this chapter, it is first suggested that the need for literacy and basic skills has grown importantly, 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 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 summary, this chapter suggests that there are important implications for the use of new technologies 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 prospect exists that technological developments could offer new tools to help meet the substantive goals of literacy and education improvement, poverty reduction, and more. Finally, it is the contention of this chapter that a UN Decade that does not place technology at its forefront will be relegated to repeat the benevolent and ineffective efforts of the past – efforts that have meant relatively little for poor people in both wealthy and poor countries alike.

Although numerous national campaigns have been undertaken globally in the last half-century (Arnove & 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 the growth of competitive and knowledge-based economies across the world, most governments and international/bilateral agencies have expressed increasing concern about illiteracy and low literacy. Resource allocations, however, have remained as a disproportionately small fraction of what is contributed to formal schooling. As discussed herein, 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 (Greaney, Khandker, & Alam, 1999).

The 1990 UN World Conference on Education for All (EFA) in Jomtien, Thailand, included adult literacy as one of its six major 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 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, formed the basis for some renewed interest in literacy and adult education in the past two decades.

The UN General Assembly proclaimed the years 2003–2012 to be the UN Literacy Decade (United Nations, 2002a), which was officially launched in February 2003. The founding resolution (i.e., 56/116) reaffirmed the Dakar Framework for Action (UNESCO, 2000) in which the commitment was made to achieve a 50 percent 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,

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curbing population growth, achieving gender equality and ensuring sustainable development, peace, and democracy" (UN, 2002b, p. 3). The 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 came during a period of significant, interconnected economic, social, and technological changes in which literacy and education have become ever more important to personal, social, and national development. Economists acknowledge that a profound shift occurred in the role that knowledge and technology play in driving productivity and global economic growth (Stiglitz, 2000), 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, productivity, and creation of new, high-paying 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 cell-phones, Web browsers, personal digital assistants, and low-cost video cameras – become more accessible and embedded in society, they are said to 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. Of course, these claims remain largely untested to date (Cuban, 2003), but there is nonetheless great public hope for ICT impact, as described in the next section.

Technology and Literacy

The UN Development Program (UNDP, 2001) provided a model that illustrates the relationship among 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, in turn, can 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 that, 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. ICT is viewed here 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 continued use of literacy skills to become life-long 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

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traditional means and sufficiently so to justify the added costs?

The goal of this chapter is to present a set of possible visions on the ways that technology can support the development of youth and adult literacy, as well as nonformal education in a global perspective (with an emphasis on developing countries). We start with a description of the status, trends, and problems related to adult literacy and issues related to the application of technology to address these problems. We then analyze various 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. We build 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 chapter concludes with implications and options for the use – or rather, necessity – of expanded roles for new ICTs in literacy development.

Status and Trends

Many countries have been actively striving to achieve Jomtien's major goal of meeting the basic learning needs for all children, youth and adults, as well as the conjoint necessity for an adequate methodology to understand 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; however, 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.

Concepts and Definitions

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.' Four of the better known definitions of literacy are as follows:

> *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)*

> *[Literacy is] 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)*

> *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)*

> *[Literacy has moved] beyond its simple notion as the set of technical skills of reading, writing and calculating . . . to a plural notion encompassing the manifold meanings and dimensions of these undeniably vital competencies. Such a view, responding to recent economic, political and social transformations, including globalization, and the advancement of* information and communication technologies, *recognizes that there are many practices of literacy embedded in different cultural processes, personal circumstances and collective structures. (UNESCO, 2005; emphasis added)*

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. Because the definitions of literacy are continually evolving, measures

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that remain the same have increasingly narrow and limited use. Constantly changing measures, however, render data invalid for across-time comparisons. However, for lack of suitable alternatives, the UNESCO data are deemed sufficient for aggregate-level analyses, provided that the limitations they present to making inferences are properly acknowledged. More detailed literacy assessments for specific populations need to be undertaken separately.

Contemporary definitions of learning competencies are prompting the development of new approaches to assessment that consider new ICTs (ETS, 2002; OECD/Statistics Canada, 2000; UNESCO, 2004; Wagner, 2005a). These approaches often emphasize the use of technology to search for and select relevant information, interpret and analyze data, and use this information to communicate effectively with others, create new knowledge products, and solve practical problems. Such assessments are currently in the development and pilot-testing phase and are scheduled for wider implementation later in this decade. Their implementation will allow researchers and policy makers to chart the development of these new skills, connect the impact of literacy programs to the requirements of the knowledge economy, and adjust policies and programs accordingly. As part of this effort, a definition of "ICT literacy" has now become important; following is one example:

> *ICT literacy proficiency is the ability to use digital technology, communication tools and networks appropriately to solve information problems in order to function in an information society. This includes the ability to use technology as a tool to research, organize, evaluate and communicate information, and the possession of a fundamental understanding of the ethical/legal issues surrounding the access and use of information. (Educational Testing Service, 2002)*

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 dialog 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 in technological development, much of it related to the invention of the computer (see Figure 30.1; adapted from UN Development Program (UNDP), 2001).

In the sixty years from the end of World War II to the beginning of the second millennium, computers evolved from bulky, room-sized machines designed to calculate military firing tables to the compact, typewriter-sized devices found in a third of American homes, in half of American workplaces, and in classrooms serving more than 70 percent of American students (Newburger, 2001), and these numbers will have increased to near asymptote in industrialized countries as we approach 2010. In less than thirty 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 and nearly-ubiquitous information system. Its structural growth has been astounding – from a network of approximately 160,000 Internet host computers in 1989 to 100 million by 1999, to billions today. In less than a decade – about half the time it took the Internet to

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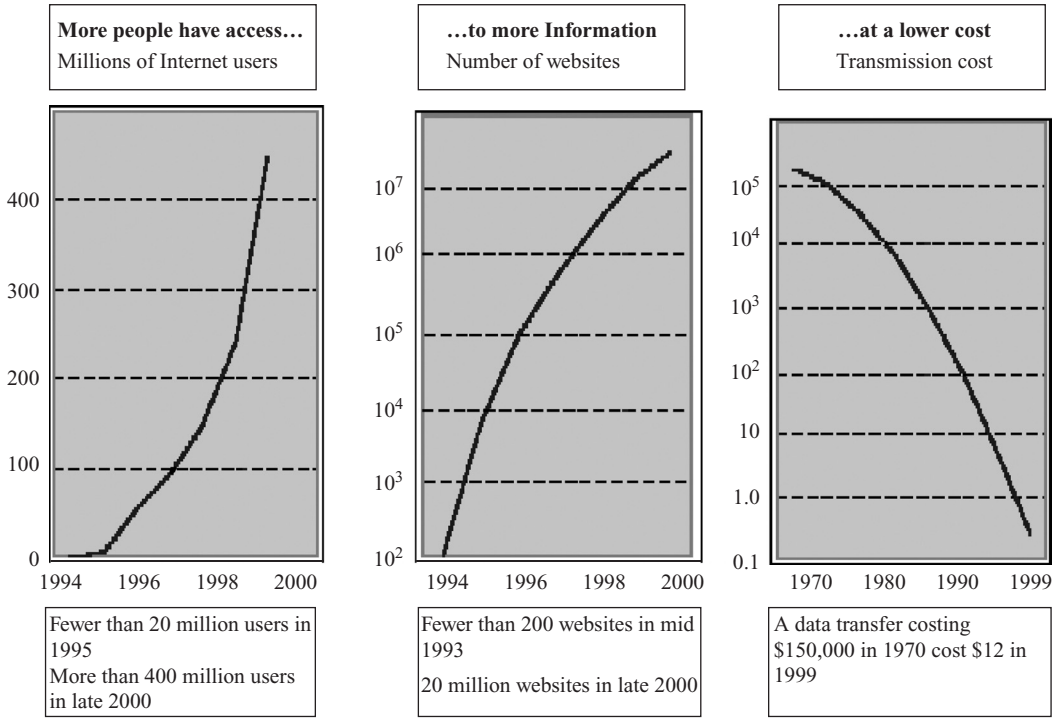

Figure 30.1. Changes in global Internet consumption.

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 nearly uncountable numbers Web sites. It was estimated that there were 550 billion individual documents on the Web as of 2000 (Bergman, 2001), with these numbers growing exponentially every year.

Such dramatic technological developments cannot help but be associated with significant social transformations, such as the economic and societal developments referenced at the beginning of this chapter (European Commission, 2000; OECD, 1996, 1999). However, although these technological and social trends are global, they have not benefited equally all nations and groups of people. The concept of a *digital divide* between the haves and have-nots in the United States and globally is nearly a decade old, and it remains a constant concern, especially in global perspective (OECD, 2001, 2002). Whereas this term originally referred to simple 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' (i.e., to the Web). Even as late as 2001, there were huge differences among the industrialized countries that form the OECD, such that Scandinavian countries had nearly five times the per-capita connectivity of countries such as Hungary, Greece and France (Figure 30.2). Although dramatic changes occurred 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 government publication (U.S. Department of Commerce, 2002), the digital divide in the United States may well be shrinking if one considers the primary parameter to be 'getting connected.' Indeed, Figure 30.3 suggests that the poor in the United States are gaining connectivity at least as rapidly as the more affluent.

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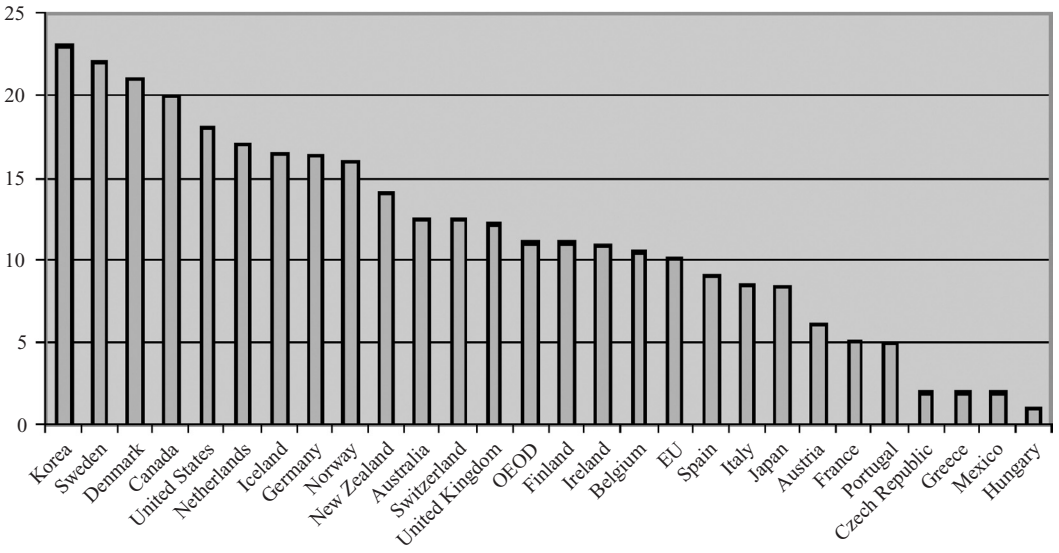

Figure 30.2. Percent Internet subscriber (per 100 inhabitants) in OECD countries, 2000.

However, some critics reviewed the same data and suggested that the key parameter in the first decade of the twenty-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 (Warschauer, 2004). This is not a minor issue, of course, because educational multimedia is increasingly taking advantage of still and moving images that require large digital files that cannot be effectively utilized on low-bandwidth, modem-based retrieval. Nowhere is this more obvious than in telecommunications-poor Africa, where Internet access has been crippled by low bandwidth. In summary, 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: the *digital language* divide. In the field of literacy, there is probably no other issue that has engendered as much debate and concern as language of instruction (Wagner, 2005b). There are those who strongly assert the need for literacy in the mother tongue and those who say that such programs are far too expensive – that social and economic dynamics are such that international languages are simply more cost-effective. Although not a major focus of this chapter, the issue of language

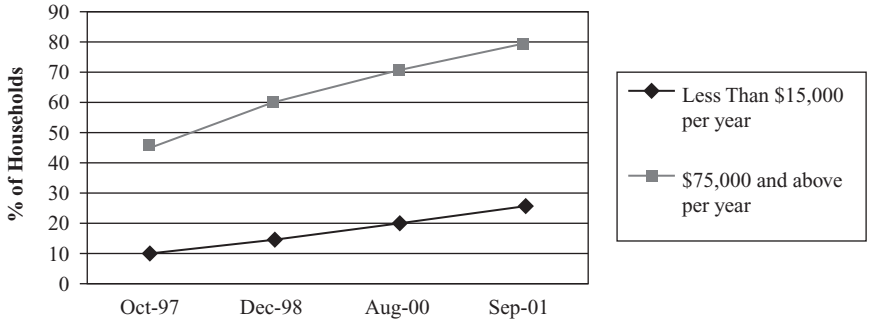

Figure 30.3. Percentage of U.S. households with Internet access by income, 1997–2001.

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of instruction (LOI) is one that has special meaning when taken in conjunction with ICTs.

One reason for this is that the Internet itself is *not* language-neutral. Indeed, recent research shows that English is more present (with 60 percent of total volume) on the World Wide Web (Web) than all other languages combined (Langer, 2001). It is interesting that the dominance of English has dropped somewhat from an even greater dominance only a couple of years earlier (i.e., 65 percent in mid-1999). Still, no other language exceeds even 10 percent of the English total (German was in second place, at 6 percent 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), metropolitan (e.g., Hindi, Swahili) and national/local 'minority' languages (e.g., Telugu in India, with 60 million speakers; or Mayan in Mexico, with several million speakers) receive relatively little digital attention.

Of course, the digital revolution did not create this situation of language dominance, which has gone on for centuries. Simply stated, literacy programs have found it difficult to teach in local LOIs for a set of well-known reasons (Wagner, 2000), 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 programs have been in existence for a long time – and this is precisely an area in which 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 decreasing regularly, whereas the costs of hardcopy printed materials are continually increasing. See one recent example, described further below, in the state of Andhra Pradesh in India, where the local LOI (Telugu) has been integrated into a multimedia platform via CD-ROM to teach basic skills to out-of-school youth as well as to elementary school children (Wagner & Daswani, 2006).

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 in society increases, technology also can be used to efficiently support education at a distance when instruction and other resources might not be otherwise available. Furthermore, the capabilities of ICTs are improving dramatically and have significant implications for the support of cognitive skills. These advanced technologies also have significant costs with implications for policy decisions. We explore these possibilities and issues in the following sections.

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 it is a cognitively demanding task for new readers (Just & Carpenter, 1987; Perfetti, 1989; Sabatini, 1999; Snow & Strucker, 2000). The reader must use decoding skills to convert the printed text into the mental equivalent of spoken words while also constructing a mental understanding of what the 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

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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 who 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 shown in the United States (Perfetti & Marron, 1995) and in developing countries (Abadzi, 2003). However, 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. Whereas 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 can be used to understand increasingly challenging texts. They become a significant resource for further learning throughout one's lifetime (Chall, 1987). Thus, these basic literacy skills become the foundation for further text-based instruction and learning.

The main productive component of literacy is writing in terms of text created (although many have argued that reading is mentally productive as well). Whereas 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 involves a command of spelling, grammar, punctuation, and capitalization sufficient enough 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 it is for narrative, informative, or persuasive purposes.

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 in and out of school and how to provide access to educational opportunities for adult learners.

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 United States and abroad (Askov, Johnston, Petty, & Young, 2003; Rosen, 2000; Sabatini, 2001; Stites, 2004; Wagner & 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 is 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 be otherwise available.

The first application of ICT draws on the interactive abilities of the computer. The computer has the nearly unique capability – compared with other (older) technologies – to accept 'input' and use this to determine its subsequent presentation

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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 mentioned, there are new tools based on computer chips called 'talking books' that do not require a computer but offer some of the same enhanced interactive capabilities, as may be seen in the "Kindle" of Amazon.com (Wagner & Kozma, 2005).

One-to-one human tutors were 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 & Slavin, 1993); the data are less clear with adult readers in the United States (Wagner & Venezky, 1999). Unfortunately, many developing countries have a significant shortage of trained teachers for classroom instruction, let alone one-to-one tutoring. Computer-based tutorials – sometimes referred to as 'computer-assisted instruction' (CAI) – augmented by multimedia capabilities may be able to provide learners with the skillful interaction that human tutors otherwise can provide. The available data on CAI innovations in early reading instruction to date come primarily from research on American schoolchildren. A typical lesson involves the presentation of instructional information in any or several of a variety of forms, such as text, sound, pictures, and video (Alessi & 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 type of response into the computer, such as selecting the best choice of multiple choices presented. The software then provides feedback on this response, which usually tells the learner if the response is correct and, if not, why it is not and what the right answer should be. With newer and better designed tutorials, feedback will be specifically tailored to the type of error that the learner has made. The analysis of the learner's response will also determine the information that the learner receives next. This type of interactivity is rarely available for individual students in classes with large enrolments and the customization of subsequent instruction is perhaps not feasible at all. These characteristics of tutorial software represent – at least, in principle – a potential benefit or advantage over classroom instruction and account for their appeal.

More powerful computers are needed to present multimedia instruction. Until recently, the software for even the newer multimedia computers has been limited in its ability to accept and analyze a variety of responses. However, these capabilities are changing, and the changes have significant implications for the needs of literacy learners.

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, 2002). The roots of distance learning go back to correspondence programs, primarily in higher education; the earliest programs in developing countries were 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 at present is focused mainly within higher education and is growing rapidly in adult education in the United States (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. Because the primary use of technology in poor countries remains in

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radio and television where there has been some evaluation research, it is useful to provide a summary before moving on to new ICTs for which less solid research exists.

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 programs) 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 used radio to deliver education to fifteen thousand nomadic women in literacy skills, livestock-rearing techniques, family care, income generation and basic business skills (Robinson, 1997). The radio program included visiting teachers and small information centers that served as meeting places for learning groups. *Telesecundaria*, a secondary-level education television series in Mexico, served more than 800,000 students during the 1997–1998 school year (Kelley-Salinas, 2001; Wolf, Castro, Navarro & Garcia, 2002). By 1990, China, India, Indonesia, Iran, the Islamic Republic of Pakistan, the Republic of Korea, Sri Lanka, Thailand and Turkey had all used broadcast media to set up national open universities, with most of these institutions having more than 100,000 students and 400,000 at the China Radio and TV University (Perraton & Creed, 2002).

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

For example, interactive radio instruction (IRI) uses a methodology that requires learners to stop and react to questions and exercises through verbal response to radio characters and engages them in group work and physical and intellectual activities while the radio program is on the air (Bosch, Rhodes, & Kariuki, 2002). Short pauses are provided throughout the lessons, after questions and during exercises, to ensure that students have time to think and respond adequately. Typically used in formal classroom settings, the program 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 that radio has to provide information in various forms and to give students feedback on their responses. Probably the best known application of educational television is *Sesame Street*, which airs in 140 countries around the world. Called *Zhima Jie* in China, *Takalani Sesame* in South Africa, and *Alam SimSim* in Egypt, it is preparing children in 140 countries around the world to begin school and literacy. For example, in Egypt, more than 90 percent of children under age eight (i.e., more than 4 million children) in urban areas and 86 percent of children in rural areas watch the show (Ward-Bent, 2002). Significantly, 54 percent of mothers regularly view the series.

Whereas 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. However, 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 & Pratt, 1999, 2000; Zucker & 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 program 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 using more sophisticated

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and expensive teleconferencing equipment. These environments make significant demands on text-comprehension skills, as well as on motivation and the self-direction of learning (Wagner & Hopey, 1999).

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 to examine the way technology is changing what it means to be a literate person. Clearly, 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 seems to be warranted, as acknowledged by the UN Literacy Decade Action Plan (United Nations, 2002b). 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 use it to benefit from and contribute to 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 analyze data; work with distributed teams; communicate with others; and use information to solve problems and create new knowledge and cultural artifacts.

Furthermore, 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 (Olson & Torrance, 2000; Street, 1999; 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. This section adds these new 'information skills' to the definition of literacy and 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. Although this broader definition may seem to be largely theoretical and conceptual, it is shown in the following discussion that there are a number of important practical implications.

Information Literacy and the Use of Digital Information

At the intersection of technology and literacy, one must consider what is already part of both mainstream and lay thinking. Notions of 'computer literacy,' 'technological literacy' and 'information literacy' not only borrow terminology from text literacy but also begin to redefine what 'text' is and the tools and skills that literate people need to use and create it (Murray, 2000; Tyner, 1998). However, it must be understood that these terms do not necessarily connote the same thing in the present discussion. An important distinction in this chapter is between the skills that are specifically required to manage technology (e.g., in 'computer literacy,' this would be using a mouse, connecting to the Internet, and so forth) and those skills that are required to manage information (e.g., how to organize, search, and produce digital information). This is what is referred to as 'information literacy.'

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Information literacy and text literacy have different implications for the skills needed to use, produce, and share information. Whereas text literacy remains the foundation for information literacy, the latter involves the convergence of text, sound, and video, and it offers the reader/viewer information in multiple media. Information presented in additional and sometimes redundant forms may reduce the skill level that is required to use information; this can be particularly important for adult literacy 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, analyze and interpret this information, critically evaluate its relevance and credibility, and to use 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 Information Technology Literacy, 1999; ETS, 2002; ISTE, 1998; OECD/Statistics Canada, 2000).

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 information society that is increasingly influenced by technology. To participate and contribute to these changes, learners must not only be able to access and manage the information of others, they also will need to be able 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 Web sites without the need to know a lower-level scripting language such as 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 & Johnson, 2002). However, training in their use can be of significant value for adult education programs in developing countries that are trying to build their technological infrastructure and human capacities.

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, Brown, & Cocking, 2000).

In their review, Nunes and Gaibel (2002) provided a useful schema for thinking about the connections between ICT and such new approaches to learning and

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teaching. Their schema is adapted herein as follows:

- *Learner centered*. 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.
- *Knowledge centered*. 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.
- *Assessment centered*. 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.
- *Community centered*. Context is important to the success of learning. Literacy programs will be more successful when skills can be used to accomplish multiple social and economic goals. Learners can gain an awareness of their place in the broader world around them, at the village, regional, national and global levels.

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, 2003a, 2003b). The studies 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 they collaborated with each other to search for information, publish or present the results of their projects or research, and design or create various digital products. As a result, teachers claimed that students acquired ICT skills, developed positive attitudes toward learning or school, and acquired new subject-matter knowledge and collaborative skills.

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 technologies 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 counties may require especially those types of skills that are described herein, which may be the most efficient route to improving literacy in poor countries. As counterintuitive as it may seem at first glance, it is the present contention that *only by using ICTs will the promotion of adult literacy succeed* in making substantial inroads in the ongoing dismal world statistics. More important, only by using ICTs will we be preparing low-literate adults for a future that will increasingly require the types 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 developing countries presents significant challenges that require novel social structures that reach beyond the classroom and into the community.

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An example of this approach may be seen in the *Bridges to the Future Initiative* (BFI; www.bridgestothefuture.org), which is designed to provide basic and information-literacy skills for the poorest of the poor, including minorities, indigenous-language speakers, and the unschooled. There are three components to the BFI: (1) development of community learning and technology centers 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 programs in India, South Africa, and Ghana. In the Indian state of Andhra Pradesh, the BFI has thirteen dual-purpose community learning and technology centers, mainly located in secondary schools to save on ICT costs. These centers, 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 offline. An additional two hundred primary schools have now been added to the BFI–India project. In collaboration with other partners, the program is providing culturally and linguistically appropriate learning resources for illiterate and low-literate youth and adults. Recent evaluation research has confirmed the significant impact of the BFI program on children and young adults in India (Wagner & Daswani, 2008).

Conclusions

We have now reached the halfway mark of the UN Literacy Decade. 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.

At the same time, if this argument is correct, it is essential to understand that neither more hardware nor more connectivity *alone* will have much effect on the positive consequences for poor people. At the policy level, most ICT resources still 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 toward the formal K–12 education sector, where the majority of national budgets reside. This needs to change if literacy is to be increased. Furthermore, literacy and technology are becoming *interdependent*. Literacy and technology are 'tools' that have much in common. Neither is an end unto itself, but each can amplify human skills and human development. Literacy education needs to take advantage of the power of technology, especially as national economies require an ever more skilled population of workers.

In this chapter, the main focus was on literacy for the poor and underserved. However, as statistics indicate worldwide, there are substantial differences between what 'being poor' means and represents in different countries, even within the poorest developing countries. As discussed, there are ICT 'digital divide' programs that may widen the divide by investing in the top (i.e., easier to reach) parts of the spectrum of the disadvantaged population. Thus, it is suggested that if the UN Decade is to succeed, it must also try to reach those at the bottom end of the literacy divide and to pay attention to how ICTs can make a special contribution.

Note

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