NEW TECHNOLOGIES FOR LITERACY AND ADULT EDUCATION:

A GLOBAL PERSPECTIVE

A PAPER IN SUPPORT OF THE
UN LITERACY DECADE, THE EDUCATION FOR ALL INITIATIVE,
WORLD SUMMIT ON THE INFORMATION SOCIETY, AND LEAVE NO CHILD BEHIND

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PREFACE

On February 13, 2003, the United Nations Literacy Decade was launched by UN Secretary-General Kofi Annan, UNESCO Director-General Koichiro Matsuura, First Lady Laura Bush, U.S. 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 paper gives us the hope that much more can be done to help the most disadvantaged groups the world over. This paper 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 paper, 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 75 developing countries, and remains an important institutional asset to those of us who wish to see the UN Literacy Decade realize its promise. The paper, released on the date of the U.S. 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 U.S. 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 paper to those who are not only thinking ahead of the curve, but also committed to making the UN Literacy Decade a success.

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EXECUTIVE SUMMARY

In January 2002, the United Nations General Assembly proclaimed the years 2003-2012 to be the United Nations Literacy Decade (UN, 2002a), which was officially launched on February 13, 2003. The founding 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 proposals and plans have come during a period of significant, interconnected economic, social, and technological change 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. The production, distribution, and use of new knowledge and information are major contributors to increased innovation, productivity, and 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 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 in 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 U.S. 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 U.S., as much as in developing countries.

The advent of new information and communications technologies (ICTs) to the above domain has generated considerable interest in many parts of the world, even though one might say that the interconnections between – and options for – literacy and technology are still not well understood by policy makers, researchers or practitioners around the world. This is true at least in part because of the wide variety of material that relates to each sub-domain. Specialists in reading acquisition are seldom conversant with adult education; those working mainly in developing countries are rarely as familiar with work in OECD countries; few in literacy are highly trained in new technologies, and conversely; and even the social science disciplines applied to the study of these sub-domains varies from the highly qualitative studies of literacy in a Sub-Saharan country to experimental studies of decoding using ICT-enabled tutorials.

A primary goal of this paper, therefore, is to present a set of possible *visions* on 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 and interconnections between literacy and technology. We begin 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. The paper then analyzes the two approaches to using ICT to support adult literacy and adult/basic education. Discussion follows on 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. The paper concludes with implications and options for policy makers in the use, indeed necessity, of expanded roles for new technologies in literacy development.

In this paper, 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 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 programs 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.

The paper concludes with a number of implications in the form of principles for action, as follows. Some are intuitive, while others are not.

a. Even within the poorest population sectors and countries, ICT is now too cheap to ignore.

b. Advanced ICT tools may be relatively *more* cost-effective for the poor than for the rich.
c. Learning technologies must have learning and content at their core.
d. ICT tools must be consumer-oriented and context/culture /language sensitive.
e. Literacy and technology are becoming increasingly inter-dependent.
f. ICT-based programs will likely need to reinforce existing government structures (rather than replace them), and enhance as a priority those areas of public education that are most in need of assistance (e.g., teacher training).
g. Private sector involvement is essential in order to take advantage of the latest ICT tools (ahead of their release to the public marketplace), and more so than in other educational projects.
h. In today's world, the concern over "sustainability" can bias projects in directions that are not necessarily most effective for the poorest learners.
i. In order to achieve effective impact in using ICT for the poorest populations, a dedicated focus will be required, as it is relatively easy to return to the most common denominator in ICT work – that of assisting those that are easiest to reach.

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.

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CAI	Computer-Assisted Instruction
CBO	Community-Based Organization
EFA	Education For All
ICT	Information and Communications Technology
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 Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
Web	World Wide Web

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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)

1. 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 25-75% (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 economic growth have similarly been said to have a similar set of broad positive consequences. 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. These matters remain under constant debate within the development community.

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 staked 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 paper, 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, and, indeed, must be done, in order to promote universal education for the 21st century.

In sum, we contend 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. Many of the most dramatic of these changes may still be some distance off in the future, and other changes may not have much effect

as yet on people in the world's poorest countries as effective solutions are still in development. Overall, however, it is the contention of this paper that a UN Decade that does not put technology at its forefront will be relegated to repeat 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 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 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).

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 Bengali 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 5000 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 market place, 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 3 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).

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 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 World War II, 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 January 2002, the United Nations General Assembly proclaimed the years 2003-2012 to be the United Nations Literacy Decade (UN, 2002a), which was officially launched on February 13, 2003. The founding 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 change 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, productivity, and 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 called 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 phone-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 labor 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 analyze 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 artifacts and to communicate effectively with others, particularly those of different backgrounds. Furthermore, continued economic, social, and technological developments require that employees and citizens must 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).

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 labor 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, along with providing the support needed to create new skills, information, 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 for the future, 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 Program (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 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. The connection between literacy, technology, and global progress (with an emphasis on developing countries) is the theme for this report. The report takes two 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 life-long-learners. The policy implications of this approach are relatively straight forward: 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, analyze, 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 & Kozma, in press). From this perspective, ICT is not just a means for delivering literacy skills but is an integral part of an information-literate society. Individual participation in this society not only involves text literacy skills but the skills to 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 justified merely in terms of a more efficient or effective means to deliver literacy training, but also as an environment which sustains literacy and development by providing a wide range of

productive tools and information by which literate people can use their skills to promote their own personal improvement and the social and economic development of the country. With this second 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, 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 programs 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 paper

The goals of this paper are to present policy makers, researchers and practitioners with a set of possible visions on 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 paper begins 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. The paper then analyzes 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 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 paper concludes with implications and options for policy makers in the use, indeed necessity, of expanded roles for new ICTs in literacy development.

2. 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 conjoint 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

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:

> 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)

> 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)

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 3 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 paper, it is suggested that information literacy will soon be part of the expansion of the term from the traditional set of reading, writing and math 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 program 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, 2002a, b; see Box 2). Data from such low-cost (minimum data required) methods will also allow impact or evaluation research on national and local programs that teach adult basic skills.

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, pamphlet, 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).

New definitions of learning competencies are prompting the development of new approaches to assessment (ETS, 2002; ISTE, 1998; OECD, 2000; Quellmalz & Kozma, in press). 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. 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 and adjust policies and programs accordingly.

2.2. Statistical trends in literacy worldwide

A recent UNESCO (2000a) review estimates nearly 862 million illiterates in the world aged 15 and above. Over 60% of the illiterate population is comprised of 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 with 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.

Table 1. Weighted Average Adult Literacy Rates in 2000 by Region and by Gender
Source: UNESCO (2000)

	Total	Male	Female
World	79.7	85.2	74.2
Developed countries and countries in transition	98.6	99	98.1
Developing countries	73.6	81	66.1
Arab States	60.1	71.7	47.8
Central and Eastern Europe	96.2	98.1	94.3
Central Asia	99.6	99.7	99.4
East Asia and the Pacific	86.5	92.4	80.5
Latin America and the Caribbean	88.9	89.9	87.9
North America and Western Europe	98.6	99	98.3
South and West Asia	55.3	66.4	43.6
Sub-Saharan Africa	60.3	68.9	52

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 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).

2.3. 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).

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 behaviors, questions on basic healthcare behaviors, assessment of information location skills, mental and written numeracy assessments, and assessments of reading and writing in Arabic. A national stratified sample of 2240 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 grand-parents 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. It clearly shows 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 by far more likely to raise illiterate children, while maternal literacy positively affects both boys' and girls' enrollment and attainment. Adapted from: Lavy et al. (1995).

Age. As shown in Table 2, the over-45 age group has the highest illiteracy rate in all regions (including OECD countries as well, but not shown in this table), which most likely can be attributed to the fewer years of schooling (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 20 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.

Table 2. Adult Illiteracy Rates (%) by Age Group and Region

COUNTRIES & TERRITORIES	AGE GROUP	TOTAL 1970	TOTAL 1990	TOTAL 2000*	MALE 1970	MALE 1990	MALE 2000*	FEMALE 1970	FEMALE 1990	FEMALE 2000*
Developing Countries	15-19	33.9	19.1	16.1	23 7	13.9	11.3	44.5	24 7	20 6
	20-24	39.8	21.5	17.3	23 2	13.9	11.3	44.5	24 7	20 6
	25-44	52.9	30.9	23.2	39 3	21.5	16.4	67.2	40 5	30 2
	45+	74.4	57	45.9	62 2	42.5	32.3	86.4	71 3	59 2
Sub-Sahara Africa	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	31.5	55 2	31.3	25	80.3	49 2	33 1
	25-44	79.8	55.5	42.4	69	43.2	32.7	90.1	67 2	51 8
	45+	92.6	82	72.5	85 6	71.5	59.9	97.3	91 5	83 7
Arab States	15-19	54.6	27.7	20.5	39 3	19.3	14.9	70.5	36	25 6
	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	55 5	34.4	24.7	88.3	63 3	45 2
	45+	85.3	76.3	66.4	74 1	61.1	48.5	96.1	90 3	82 1
Latin America/Caribbean	15-19	14.6	6.2	4.1	13 3	6.1	4.2	15	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	11.5	8	28.3	13 7	24 3
	45+	37.3	27.5	21.4	31	23.1	18.2	43.3	31 5	24 3
Eastern Asia	15-19	19.5	6.3	3.5	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
	25-44	43.8	16.8	9.3	27 9	9	5.5	61	25	14 2
	45+	78	51.8	36.2	63 5	34.1	20.9	91.5	69 4	51 3
Southern Asia	15-19	56.7	37.7	29.4	42 7	26.3	20.7	72	49 5	33 6
	20-24	61.1	42.3	33.4	45 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

Source: UNESCO (1990)

* Estimated

Rural-urban. It has long been understood, in developing countries especially, that 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 show that illiteracy is much more prevalent in rural communities than in the urban areas (see Table 3).

Table 3. Rural-Urban Illiteracy Rates in Selected Countries (Populations Aged 15 Years and Over)

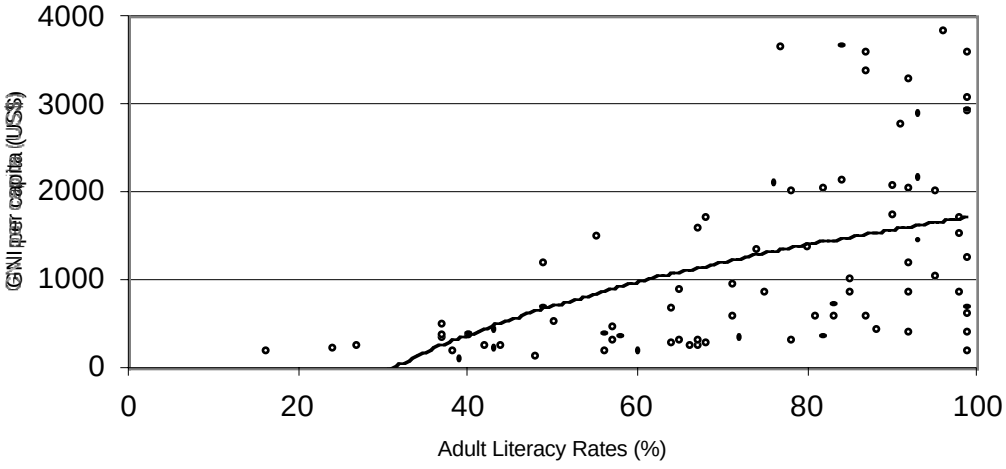
COUNTRY	RURAL AREA	URBAN AREA
Afghanistan	85.3	62.5
Pakistan	82.6	53.1
Nepal	81.3	52.6
Togo	78.3	43.1
Bangladesh	74.5	51.8

India	67.3	34.9
Tunisia (age 10+)	62.2	35.3
Brazil	46.3	16.8
Dominican Republic	43	20.9
El Salvador (age 10+)	42.2	15.5
China	37.8	17.6
Indonesia	37.6	16.5
Malaysia (age 10+)	32	19
Ecuador	27.3	6.2
Colombia	24.8	9
Philippines	23.1	6.9
Sri Lanka	15.2	6.6
Argentina (age 10+)	14.6	4.1

Note: Data are from censuses carried out between 1980 and 1982
Sources: UNESCO (1998)

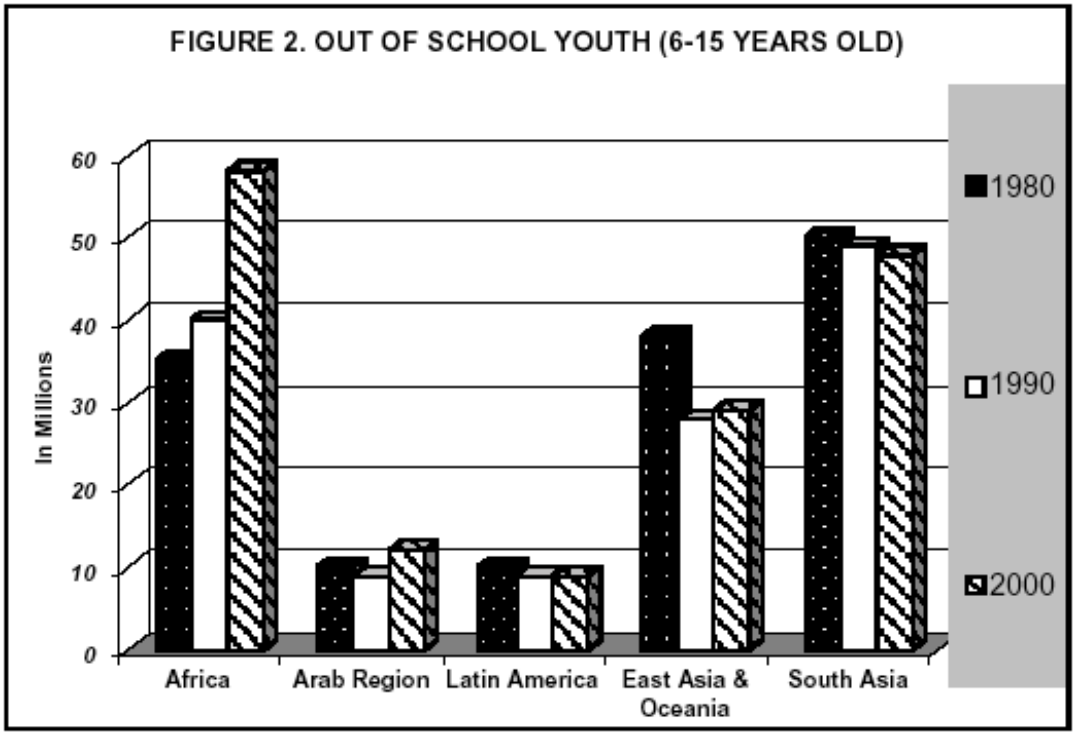
Schooling. Primary schooling and adult illiteracy are highly (and inversely) correlated, in particular since most developing countries use the rate of primary schooling as a principal proxy variable for determining who is labeled as "literate." In addition, it is clear that levels of out-of-school youth, in spite of increases in the rate of school enrollments in LDCs, continue to be high, and are growing rather dramatically in Africa (see Figure 1**)**. 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.

Figure 1. Adult Literacy rates (age 15+) and GNI per capita in developing countries



Source: World Bank (2000)

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



Source: UNESCO (1997)

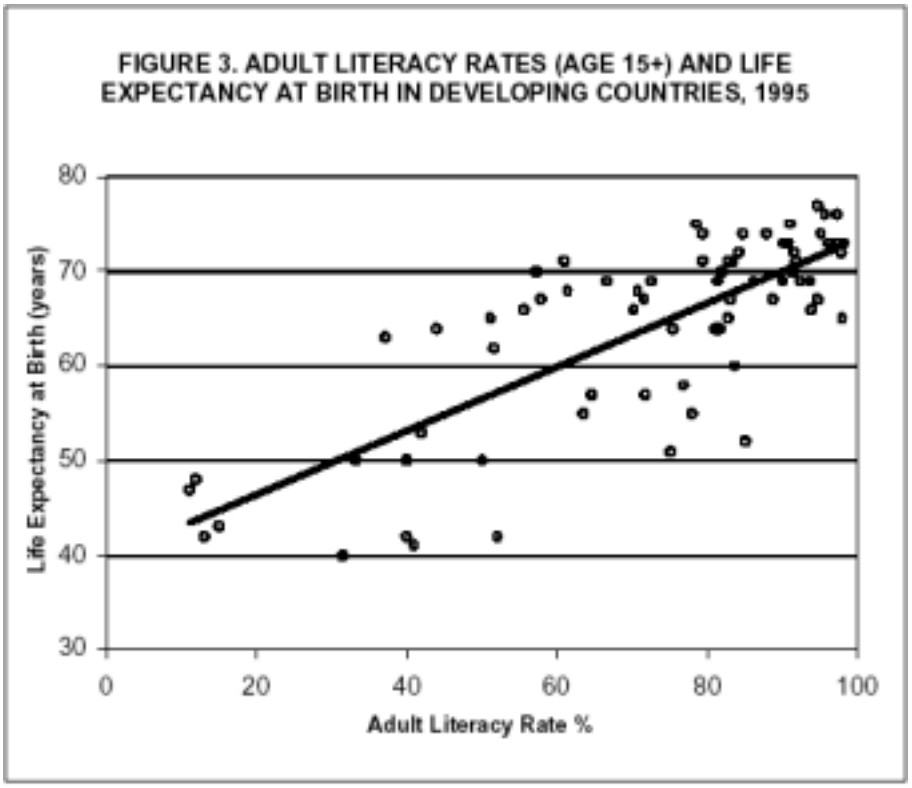
Furthermore, given the common recognition of the key roles that women play in fertility planning, infant care/nutrition, and the health education, it is not surprising that female illiteracy is seen as a major obstacle to health and social development (see Box 4). It should be recalled, as with many cross-national analyses, that correlations between female literacy and health indicators are often statistically significant even though there is remarkably little evidence which 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).

Box 4. Women, health and literacy education in Senegal

The TOSTAN Basic Education program 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 program also integrates elements of traditional culture into the curriculum and promotes community ownership and problem-solving to improve living conditions in the villages. The program includes a module on the use of Oral Rehydration Solution (ORS), which prevents the dehydration caused by diarrhea, 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 diarrhea 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 program that will improve their communities' health conditions. Adapted from: TOSTAN (1996).

Economic. There is a widespread belief in this country and worldwide that literacy and economic well being (at the individual and national level) go hand in hand (Windham, 1999). This is apparent in Figure 3, which shows a plot of GNP per capita against adult literacy rates in developing countries.



Source: UNESCO (1997)

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 & 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.

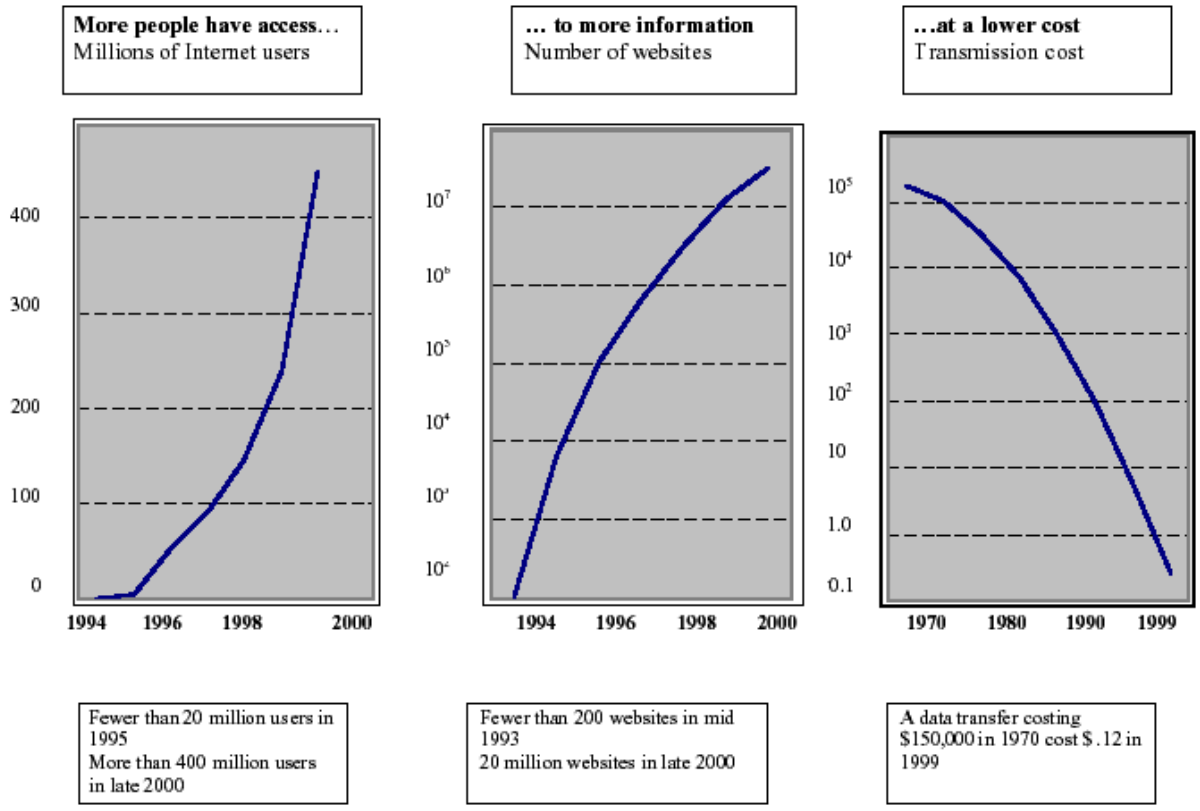
2.4. *Trends in technology development*

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 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 4).
Source: UNESCO (1997)

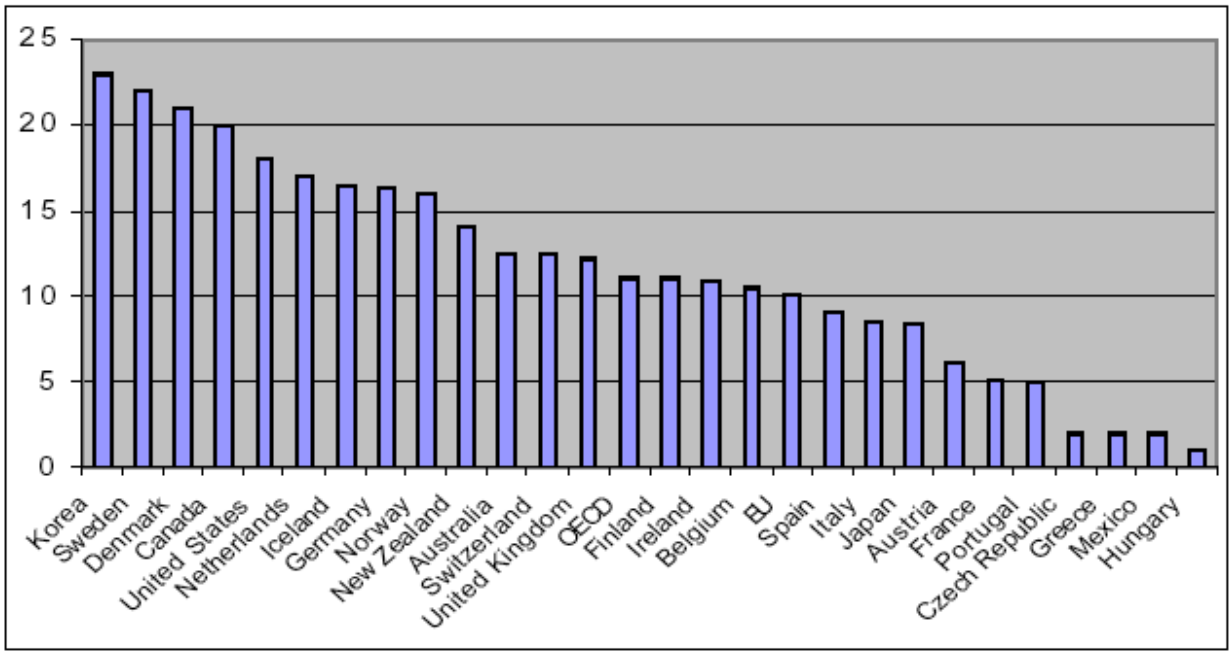
Figure 4. Changing international trends in Internet Use



(Adapted from UNDP, 2001)

In the 50 years from the end of World War II 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 percent of American students (Newburger, 2000). In less than 25 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 to100 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.

Figure 5: Percent Internet subscribers (per 100 inhabitants) in OECD countries in 2000

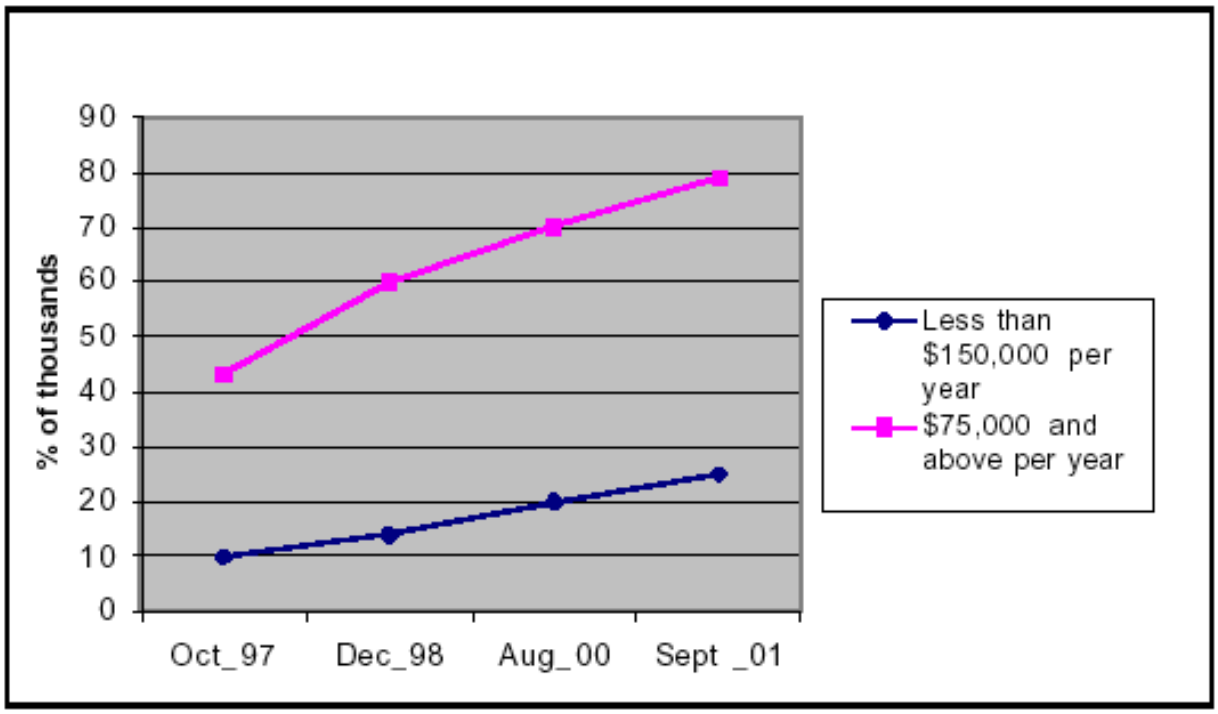


(Adapted from OECD, Telecommunications Database, June 2001)

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 paper (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 U.S. and globally is nearly a

decade old, and it remains a constant concern especially in 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, such that Scandinavian countries had nearly five times the per-capita connectivity than countries like Hungary, Greece and France (see Figure 5). 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. Furthermore, as noted in a major U.S. government publication (Department of Commerce, 2002), the digital divide in the U.S. may well be shrinking if one considers the primary parameter to be 'getting connected.' Indeed, Figure 6 suggests that the poor in the U.S. are gaining connectivity in 2003 at least as rapidly as the more affluent.

Figure 6: Internet Access by Income in the United States (1997-2001)



However, critics have reviewed the same data and suggested that the key parameter in 2003 and beyond 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 probably no other issue that has engendered as much debate and concern as language of instruction (LOI; Klaus et al., in prep; 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 programs 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 paper, the issue of LOI is one that has special meaning when taken in conjunction with ICTs.

Box 5. Language development for literacy: The Shiyeyi in Botswana

Since independence, the government of Botswana has practiced an exclusive language policy, in which only English has been used in government circles, at the exclusion of all 26 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 programs. 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 Kamanakao Association has been to conduct participatory training and research workshops in villages throughout the Shiyeyi-speaking region. These workshops have been to collect data for developing the orthography, to record oral literature, and survey 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).

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 important 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 lack of adequate language competence and learner self-confidence, as well as 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. In 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 on the World Wide Web (Web; 60% in mid-2001) 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). While 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); national/local 'minority' languages (e.g., Telugu in India, with 50 million speakers; or Mayan in Mexico with several million speakers) receive 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 which has been, as noted above, a source of difficulty for the print media in literacy programs worldwide. Simply put, literacy programs 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 programs 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 digital language divide can be bridged more easily that the language-in-print divide, if only because translation and production costs in digital media are decreasingly regularly, while the costs of hardcopy printed materials are continually increasing. This is clearly an area that merits further attention in the coming years.

2.5. 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 program practices, ideally conducted by researchers who are independent of the planners. Studies would focus on planning and strategies for literacy work, program 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). Many programs have inadequate documentation procedures, much less usable evaluation data (Diagne & Oxenham, 2001). 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 programs. Indeed, it may be that one of the key impediments to expanding public and government support for adult literacy programs has been the failure of those who support international adult literacy programs 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 analyze the effectiveness of literacy and adult education programs as they operate in a variety of settings on the ground. These efforts, commonly thought of as program evaluation work, constitute an important element in our understanding of literacy and adult education, and how service provision can be improved and expanded.

The cost of adult education programs is assessed by the expenditure per person who is enrolled and completes the program. Program 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 $12 to $74. This does not include the implicit costs (such as income foregone) of participating in a program. The wide range of unit costs among programs indicates variation in program efficiency, and most likely, program effectiveness. This unit cost is sensitive to participant attrition, as disequilibrium in enrollment and completion rates drives the unit cost up.

Government-led adult education programs are cheaper than agency funded programs, as low as $1.93 in Bangladesh to $25 in Senegal (Oxenham, 2000). This is because World Bank programs incur most of their cost in management (e.g. facilitators, coordinators, operational expenses), while government programs 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 & Oxenham, 2001), 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 a 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.

3. TECHNOLOGY IN SUPPORT OF LITERACY AND BASIC SKILLS

How can information and communication technologies support the acquisition of literacy and basic skills? One approach is to use the capabilities of technology to deliver instruction in support of the cognitive skills needed to read and understand text. This core skill is not only of value in itself but is essential for using text to learn other important skills. In a second approach, technology can be used to efficiently support the use of text and developing literacy skills for

learning at a distance when instruction and other resources might not otherwise be available. Further, the capabilities of ICT 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 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 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 a difficult word or 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 and available to support decoding. 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, is a major problem for adult illiterates, at least according to U.S. studies (Perfetti & Marron, 1995). 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 can use to help with decoding. While the specific purposes and background knowledge varies 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).

The main productive component of literacy is writing in terms of text created (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 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 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 & Scardamalia, 1987; Flower & Hayes, 1981). But these more complex, cognitive skills do not come easy for many learners. For example, in a recent U.S. study (National Center for Educational Statistics, 2003), students in most grades showed significant improvements in writing skill compared to previous years, however *most* students 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 study 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.

One caveat to the present discussion: It has often been reported that one of the most troublesome skills for literacy learners in poor LDCs is that of *handwriting*. Indeed, some specialists have argued that the (often) initial emphasis of 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. Now, the word processor with a keyboard (see more on this below) seems even more intimidating to learners in both LDCs and in industrialized countries. Yet, we may find that the future will demonstrate that adult literacy learners, in very disadvantaged locations, may find that the word processor provides an easier route to text productivity, much as the Internet has already done for secondary students who 'cut and paste' their way to term papers. This is an area the merits further attention in the coming years.

In sum, when considering the use of new technologies, there has been a focus not only on how to provide access to adult learners but also how to structure the use of technology to be most effective for the kinds of skills necessary to deploy literacy skills both in and out of school.

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 U.S. and abroad (Askov, Johnston, Petty, & Young, 2003; Rosen, 2000; Sabatini, 2001; Stites, in press; 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 will be on beginning reading, which has received the most attention in ICT-based instruction. Secondly, technology can be used to efficiently support the use of text and developing literacy skills for learning at a distance when instruction and other resources might not otherwise be available.

The first approach to using 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 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 called 'talking books' (e.g., *LeapFrog*; http://www.leapfrogschoolhouse.com/home/index.asp) that 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 & Slavin, 1993); the data are less clear with adult readers in the U.S. (Wagner & Venezky, 1999). Unfortunately, LDCs 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" or CAI — may be able to provide the learner with the skillful interaction that human tutors can otherwise provide. The available data on CAI innovations in early reading instruction to date come from research on American school children, as detailed below.

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. 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 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 kind 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 enrollments and the customization of subsequent instruction is, perhaps, not feasible at all. These characteristics of tutorial software represent, at least in principle, a significant benefit or advantage over classroom instruction and account for their appeal.

Newer and 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 analyze a variety of responses. But these capabilities are changing, as discussed a bit 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 program 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 present additional words with the same phonetic base and students would be asked to apply the decoding rule to read these words. The computer could analyze 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 provide 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. For example, *Lexia Reading Strategies for Older Students* (Lexia Learning Systems: Lincoln, MA) is designed for students ages 9 through adult. The software is presented in a mature interface. 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 4 CD-ROMs designed for English-as-a-second-language 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.

Often costing several hundred US dollars or more, literacy tutorial software can be expensive. Further, since the programs 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 programs 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 U.S. Investments are required both for a sufficient numbers of multimedia computers to service the learners and 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 as well as 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 of using word processors have now become an important part of "computer literacy." The growing availability of personal computers and word processors in the 1980's, at least on college campuses in the U.S., corresponded to 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 & 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 & Glynn, 1989; Daiute, 1985; Hawisher & Selfe, 1989). An extensive review of experimental studies of the use of word processors for the teaching of writing found significant favorable 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).

3.3. ICTs in support of distance learning

The lack of sufficiently trained teachers is often the justification for a second type of technology application — namely, learning at a distance. Distance learning is playing an increasingly important role in developing countries (UNESCO, 2002b). The roots of distance learning go back to correspondence programs, primarily in higher education, with the earliest programs 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 U.S. (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 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 15,000 nomadic women in literacy skills, livestock rearing techniques, family care, income generation and basic business skills (Perraton & Creed, 2002; see Box 7). The radio program included visiting teachers and small information centers 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, 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, most of these institutions having more than 100,000 students and 400,000 at the China Radio and TV University (Perraton & 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 labor 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 meager resources to produce marketable goods, requiring skills relied on 60 years earlier that were now unfamiliar, forgotten, or in need of improvement. The Gobi Women's Project, started in the early 1990s, is a non-formal distance learning program 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 batteries for them and relevant booklets. Learning materials were supplemented by newsletters, demonstration materials, and information sheets. Teachers traveled to the women's homes to check their progress and help them with any specific problems. The program covered such topics as health, survival and income generation, business, as well as literacy and numeracy. Participants reported that not only were they satisfied with the new skills they acquired through the program, 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 programs started off in "talking head" format and they 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 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 the 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.

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 program for primary students in South Africa, served nearly 25,000 students in 1995. In the Republic of Guinea, IRI was used along with printed materials to help move the country's educational system from one that focused on a lock-step curriculum, teacher-centered 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 program 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*, in Egypt it is known as *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 age eight (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, the educational television is more often used for basic education. With these applications, television programming is coordinated with a formal curriculum and coordinated with in-school or out-or-school activities. *Telecurso 2000* in Brazil is targeted at young adults who left primary or secondary schools before graduation. In the early 1990's, the program was started as a joint venture between the Federation of Industries, the State of Sao Paulo, and the Roberto Marinho Foundation to prepare to increase 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 program are to provide people with basic skills of reading, writing, counting, and solving mathematical problems; prepare them for jobs; promote their participation in civic and cultural life; and 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. In 1998, nearly 18% of the

countries total enrollments in those grades participated in the program (Wolf et al., 2002). *Telesecundaria* is an integrated and comprehensive program providing a combination of distance and in-person support to students and teachers. The program 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 15 minutes of television, the set is turned off, and the next 45 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 newness, 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 reproduction the face-to-face experience online, with teachers and students holding discussions in a virtual space, either synchronously or asynchronously. These meetings may be conducted as online "text chat" or using more sophisticated 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 U.S. included participating schools that 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 catalog. The participating high school, in turn, would receive 25 "slots" in which any of their students could enroll in any of the courses in VHS's catalog. 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 the end of the year, for a two-term course. 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 netcourses 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 program, 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 as high as or higher on assessments 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 31 learning centers at 17 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 programs to over 23,000 students.

At the secondary level, the World Bank started the World Links for Development (WorLD) program as a pilot project in 1997 as a way to install networked computers in high schools in developing countries. Since renamed as World Links and spun off as a separate non-profit organization, the aim of the program 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 program 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 26 developing countries in Africa, Latin America, the Middle East, and Southern and Southeastern Asia. In a three-year evaluation of WorLD, Kozma et al. (2003, in prep) found that despite barriers encountered by WorLD teachers, students in the program 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. They illustrate how significant, large-scale efforts can begin to bridge the digital divide and support learning at a distance. They are a beginning point and present the prospect of exploring other ways to think about how technology can influence literacy and adult education in developing countries.

Online adult education in the U.S. The United States has an important confluence of both high need of adult basic education and the financial means to support a robust ICT-based development program. In a recent review, Askov et al. (2003) describe several new efforts in the U.S. 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-1990's. 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 programs in the U.S. 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 finding were that adult learners showed strong motivation when actually in the program. However, like most non-online programs, retention remained a serious issue, with an average of only about 40% of learners in the evaluation study (Askov et al., 2003, p. 40). This rate is within the average range of adult education programs more generally, and points to the complexities of using distance education to reach those 'anywhere at anytime.' The evaluation study did show some evidence (based on teachers' estimates) that about half the enrolled learners were less likely to participate if there had been no online service available. More substantive data on this issue will be important in future developments in the U.S. Other state-based experiments are underway in the U.S., 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 & Hopey, 1999).

Box 8. LiteracyLink: Internet-based adult basic education in the United States

In 1996, the U.S. 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 program known as *LiteracyLink*. This program 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 U.S. 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 web sites that have been evaluated for adult learning, and a database of Internet-based lesson plans. Adapted from Wagner and Hopey (1999).

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 *analyze* and respond to input with any sophistication.

From the standpoint of the computer, the easiest kind of input for it to accept and analyze is a simple mouse click on a multiple choice or true and 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 program, 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 decoding, students need to be able to speak the sound of a presented word, phrase, or sentence, and the computer should to be able to accept this speech, know if it is correct or analyze 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 in writing — 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 have been used infrequently to date 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 require high-end (i.e., expensive) machines. Consequently, their near-term potential for literacy instruction in the U.S. or developing countries is 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 the important sounds from other sounds in the room. Importantly, the software can run on commonly available multimedia computers. For example, with *Dragon Naturally Speaking* (ScanSoft: Peabody, MA) the training time is about 5 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, CA). 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 children's learning of literacy decoding skills, for example, *Let's Go Read* (Edmark: Novato, CA).

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, webpages, or typed text. *Keystone ScreenSpeaker* (Words Worldwide Limited: Newcastle upon Tyne, UK) is a screen reader program 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 battery-powered computer chip that provides text-to-speech capability to early readers, primarily young children at this point in their marketing. 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. 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 like 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, Flotz, & Laham, 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, such as physics, and to simulate the instructional moves of human tutors. *AutoTutor* appears on the screen as an animated talking

head that acts as a dialog 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-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 for literacy is still in the future, especially in LDCs. Yet, the promise that AI offers for literacy learning is that the computer will come 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 equipment that is affordable, and whether the significant investment required will be made to use these technologies to develop literacy tutorials in the languages that are needed by these countries. The investment required to develop and use computer-based tutorials may be justified most when skilled literacy teachers are not available in numbers sufficient to provide students with the personalized instruction that they often need because their of lack 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 programs, 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 than1000 times greater than that produced by a PC in 1980. Further, the number of Internet hosts grew 1,100 times between 1992-1999 (Haddad & Draxler, 2002).

Furthermore, it is not as often reported that the 'entry' into any new technology can be expensive (e.g., flying more advance jet aircraft). However, while this was seemingly true in the early days of computing (i.e., its first two decades), the ease-of-use has grown tremendously, so that even the most powerful computers today are often much easier to use than the less able computers of only a few years ago.

More specifically, however, it has been noted that literal cost is an instrument too blunt for 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 does it do at least as good if not better job in 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, that will help given initial interventions a longer shell life.

Of course, these are only a few of the key questions. But how does 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-date. Based on data in Table 4, we can see that a variety of technologies have been used, with per learner costs ranging from $22-441; of course, these figures tell us little about the real per-learner costs, how much learning achievement, how money was distributed across types of specific cost.

Table 4. 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, Colombia, Radio Santa Maria, Dominican Republic	ACPO: 190 000 student; RSM 20 000 students One-year course offering equivalency to primary education	In range $50 to 88 per student per annum	Cost at ACPO less than for primary schools. At RSM comparable with primary, lower than evening classes

Zambia radio education campaign on cooperative movement	4730 participants Ten weeks of meetings, once weekly	$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	1500 students Eight meetings at weekly intervals	About $46 per student	Cost probably low in comparison with alternatives, high as compared with primary schools
Telesecundaria * Mexico		In range $441 - 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

Source: Perraton, 2000

* Figures from three studies in 1975, 1988, 1997. One further study in 1981 had figures of $927.

In the review cited earlier (Haddad & Jurich, 2002), there is a helpful analysis of costs. 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 1-3 dollars/learner) as the denominator in many countries goes into the hundreds of thousand of individual learners. Of course, considering cost-effectiveness only by the above equation necessarily ignores the parameter (and critical issue) of learning achievement. Further, reaching youth and adult learners provides relatively little knowledge on whether individual lives are improved. What is missing from most of these cost analyses (such as in Table 4) 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., 2003 in prep).

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 programs. In Table 5, 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 programs may work well and are not very expensive. More recently, in the WorLD program, Carlson and Gadio (2002) report that their 'full program' would cost about

$625 for a full 250 hour program, a cost well within the parameters of what many governments spend on teacher training without ICT.

Table 5. Costs and effects of some international teacher education projects

Currency: constant 1998 US dollars

Country, project, date [a]	GNP per capita at time of study		Student numbers	Average cost	Educational and cost impact
	Date Current US$	1998 US$			
Tanzania TTD 1979-84	1982 310	524	15 000 p.a. 45,000 total	1863 per student p.a. 7316 per graduate	Effects comparable to conventional education. Cost about half conventional education
Brazil Logos II 1976-81	1978 1650	4125	24 400	211 per student p.a. 741 per graduate	80% pass rate. Costs lower than alternative
Sri Lanka 1984-8	1986 410	610	c5000	116 per student p.a.	Cost 1/6 - 1/3 of alternative. More effective than alternative for some subjects but less effective for others
Indonesia 1985-8	1986 530	788	c5000	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	3000	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	1145	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 AIOU graduate 45-70% of conventional university
Kenya inservice teacher training 1968-77	1972 180	661	790	806 per subject equivalent p.a.	Cost relatively high; favorable effect on access
Kenya University of Nairobi BEd 1986-90	1988 370	510	515	1096 per student p.a.	Cost thought to be lower than cost of residential equivalent
Nigeria COSIT University of	1984 730	1145	2000	345 per full-time student equivalent	If opportunity costs are omitted then cost per graduate slightly lower than residential campus

Lagos 1980-8				1304 per graduate	cost
Uganda NITEP project 1993-7	1995 240		2750 257	2000 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 program.

The present discussion has primarily focused on people costs, that is, on the cost of teacher involvement, 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 U.S. has many examples of federally supported projects that are funded by research dollars but often are not fully or even partially commercialized to the broader public. Some, such as *LiteracyLink* and *Professional Development Kit,* have fared somewhat better as individual states in the U.S. have opted to support these programs 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.

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 6 (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 dealt with simultaneously, thereby confirming what is known by most who buy technology – it is not very easy to accomplish rationally. It is no surprise, therefore, that ICT has become one of the most difficult of decisions that educational policy makers have to make today, often under conditions of considerable uncertainty about what really works best.

Table 6. Technology choice and costs from developing country perspective

Technology	Pre-requisites	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	Distribution costs	Mainly central

	only	likely to make cost uncompetitive with radio when audience > 500	
DBS	Access to transponder, uplinks and down link 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 center. Specialized equipment at satellites	Likely to exceed conventional teaching where tutors are employed at each site	Expenditure need both centrally 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.

4. TECHNOLOGY IN SUPPORT OF A BROADER VISION OF LITERACY

Another approach to the use of technology in support of literacy is to examine the way technology is changing what it means to be a literate person. As networked computers, wireless PDAs, video cameras and other information and communication technologies become integrated into everyday life and as information is increasingly codified in digital form, additional skills are needed to operate the technology and use it to benefit from and contribute to society and the economy. 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 — what is sometimes referred to as “basic skills plus.”

Further, literacy has come to be viewed by researchers as 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, 1999b; Wagner, 1995, 2000). This broader notion of literacy better fits the needs and reality of adult literacy learners and users 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 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 are 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 developed countries, implications for developing countries are significant as they formulate policies and programs that jump start the "high road" approach to the technology-knowledge-economic development spiral so as to benefit the economy, 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, and so forth), and those skills required to manage information (for example, how to organize, search, and produce digital information).

In this paper we interpret the new *information* literacy to be a straightforward extension of the older *print* literacy, but with several important caveats driven by the requirements of ICTs. Thus, the convergence of text, sound, and video on the computer offers the reader/viewer information in multiple media. Increasingly available audio equipment and digital cameras, along with software packages make it easy for anyone with the necessary skills to create multimedia products in a variety of forms in addition to text. 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. In addition, the widespread – indeed worldwide – distribution of information no longer requires a printing press or access to a publishing house. Anyone with a computer set up in the appropriate way, an Internet connection, and the necessary Webpage design tools and skills can make their intellectual contributions available to millions of Internet users around the world. As a consequence, 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 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 Informational Technology Literacy, 1999; ETS, 2002; ISTE, 1998; OECD/Statistics Canada, 2000; Quellmalz & Kozma, in press).

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 (OECD, 1996; European Commission, 2000). Thus, there are new skills and tools that must be acquired to support this acquisition. The following sections examine the skills and tools that can be used to support the creation of knowledge products, the social contexts that can support and be supported by these skills, and the kinds of digital resources that can be of use to literate communities.

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 programs. 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 10-20 years ago and 91% said it is "very" or "somewhat" important to prepare young people with 21st Century (Information) Literacy skills. And while 74% of U.S. 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 in the 21st century

Literacy in the 21st century will increasingly be used within a multimedia, interconnected ICT environment 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. Increasingly, this information will be created and stored in a number of media forms. In a recent review, Nunes and Gaibel (2002), building on the work of Bransford, Brown, and Cocking (2000), provide a useful schema for thinking about ICT to imagine the future uses of literacy. Their schema is adapted here 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. Furthermore, students will be able to direct their own learning. As they become more knowledgeable and their literacy skills increase and they can use technology to design their own learning plans and create their own knowledge products.

- *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. 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 21st century.

- *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. 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 program director with useful information on the status of learning achievement of the individual learner or group of learners.

- *Community centered*. Context — particularly social context — is important to the success of learning. Literacy programs 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.

Thus, we become aware of the possibility that this broader vision of literacy is one where information and communication are dual goals, and an array of cognitive and social skills will be required to take full advantage of what ICT will offer in the coming years and decades. While in Section 3, technologies were shown to support the acquisition of new skills and tools, in this section, technology can be shown to create digital products *and* support community-centered approaches to learning and literacy.

The Internet, literacy, 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. As noted earlier, within this interconnected digital

environment, learners will need to be able to access and manage the information of others, and to produce their own digital content, what are now called multimedia digital products.

Web authoring packages are a set of 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. However, much like word processors, they were not developed specifically for student use or to support the cognitive processes needed to design web documents. Rather web design packages were designed to support professionals who prepare materials for publication on the World Wide Web. Consequently, their educational use has been primarily for vocational or technical education, where students are taught skills that prepare them for jobs (Eisenberg & Johnson, 2002). This use of web design tools relates most directly to the development of "computer literacy." 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. 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.

Networking and literacy. While word processors, Web authoring packages, and other multimedia tools may support the creation of written products, defined broadly, other tools and approaches are needed to support the social processes of literacy. One application of this 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, Payton, & Batson, 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 (written 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" in which students engage in person-to-person and online discourse to collaboratively build a shared, 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. This goal fits well with the needs of a knowledge economy and information society that focus on the creation of knowledge as the primary source of new economic and cultural value (European Commission, 2000; OECD, 1996, 1999).

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 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 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 ongoing 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.

Social construction of literacy. There are various 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 U.S., to the work of Barton and Hamilton (1998) in the U.K. 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 U.S; 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).

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 neighbors. For those with poor skill levels, these literacy transactions can help 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 Centers. Probably the best known example of how community literacy and technology come together is apparent in the emergence of community technology centers (CTCs) or "telecenters." In the U.S., the development of these centers has been encouraged by federal support for Community Technology Centers program (U.S. Department of Housing and Urban Development, 1999; Michalchik & Penuel, 2003). The program uses CTCs to increase access to technology and promote the use of technology in education in urban and rural areas and economically distressed communities. These centers provide access and training related to the use of hardware, software, and the Internet, as well as other services. The programmatic focus differs from center to center and ranges from providing after-school academic support to children and improved home-school connections to technical training in ICT skills to laid-off laborers and adult literacy and English language skills in ethnically diverse neighborhoods. Some centers in the U.S. are specifically designed for the needs of adult literacy learners; more recently the U.S. Department of Education intends to focus on at-risk youth at the secondary school level.

In LDCs, telecenters 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 U.S. CTCs. Some may be private, commercial centers, sustainable by 'user fees'; others may be sponsored by a university, school, NGO, or municipality. Commercial centers, such as Internet cafes, may not have a specific programmatic focus but rather are open to the public. University-sponsored centers may be connected to social outreach programs or off-campus course offerings. School-sponsored centers 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 & Laval, 2003) where computers have been put in 100 percent of the nation's secondary schools and more than 50 percent of the primary schools. The program 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) program 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 program has been set up in El Salvador (see Box 9). New and mixed-use ICT telecenters are also finding their way in development, such as in the wireless program in the Dominican Republic (see Box 10), and mixed multiple combined ICT model in Sri Lanka (see Box 11).

Box 9. Telecenters, El Salvador.

The *Infocentros* Telecenter model in El Salvador is an ambitious effort to promote the rapid spread of information technology in the developing world. Its emphasis and recognition of its role in generating a demand for computer and Internet access. With a goal of bringing access to a third of total national population (roughly 2 million), particularly lower and middle income, its potential promise lays 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 telecenters in 3 years, *Infocentros* is able to avail of 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 centers. Source: http://www.digitaldividend.org/action_agenda/action_agenda_01_infocentros.htm

Box 10. Wireless Internet access, 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 e-mail and other program 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 neighboring 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 e-mail or local voice over IP 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, 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 3 computers, a dedicated 64kbps 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 program 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 laborers. This raises awareness about the uses and benefits of information, as well as minimizes the intimidation some may feel toward 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 maintaining a website (www.kothmale.net) with locally generated content.

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

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. The access to computers and the Internet provided by CTCs can be combined with training in ICT skills (skills such as accessing and managing information and creating multimedia, digital products) which 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 not only to provide community members with access to the

Internet but access to specially designed, government-supported portals that have linguistically and culturally appropriate and highly relevant content related to health, nutrition, family planning, continuing education, employment, and agriculture – information that people with new literacy skills could use to improve their lives. They can use them to represent the local culture to the rest of the world and enlist global resources for local ends. Programs 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.

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 percent of the tribal community's population lives below the poverty line, and 50 percent 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 18 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 programs 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 planed 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

While some CTCs are generally open to the public, others may make try to target key populations. An example of this approach may be seen in the *Bridges to the Future Initiative* (BFI; www.bridgestothefuture.org) which is intentionally 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: development of community learning and technology centers for lifelong learning, basic and ICT skill acquisition, and high-impact information resources in local languages; development of ICT-based tools to improve teacher training; and 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, for example, the BFI has18 pilot 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 off-line. Teacher training materials will be

developed soon. In collaboration with other partners, the program is providing culturally and linguistically appropriate learning resources for illiterate and low-literate youth and adults (Wagner, 2001).

4.4. Some emerging concerns on ICT and development

Of course, 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 learning achievement, whether in children or adults, whether in industrialized or development nations. Part of this dearth is due, it seems, to the confluence of two factors: the essential attractiveness of ICT to the parents and community (including business community seeking skilled labor), along with the rapid changes in both software and hardware products that makes 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 U.S. (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 one of the best reviews of ICT and development in LDCs, the UNDP (2001) has 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 paper. 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 paper, 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 way, not only through the provision of ICT.

Source from UNDP et al., 2001.

There are, of course, other areas of effectiveness that need attention, and a full and detailed compilation would go beyond the scope of this paper. 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 programs 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 of 'truth in advertising' in the broad field of ICT and development. One good example is the notion of 'Digital Divide.' 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 on the UN Decade as well unless special care is taken to support ICTs that indeed favor 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.

5. CHALLENGES FOR THE FUTURE

The international statistics on literacy in the year 2000, dramatic as they are, do not fully reveal the endemic problems associated with adult literacy work in today's world. The central issue for literacy, as with the broader field of education, is the *quality* of the education as it relates to the *individual* youth and adult learner. National campaigns and programs have often gone wrong because of the need for too rapid progress and for simple-minded economies of scale. This combination of factors has led to low motivation on the part of youth and adult learners, and to poor outcomes in both learning achievement and participation rates. Literacy, basic and adult education will need to focus more than ever before on which *kinds* and what *levels* of literacy are required for each society, as well as for specific groups within that society. What is needed is a

greater focus on program quality that improves both instruction (by human and/or ICT means) and learning. In the following section, various key dimensions adult literacy are discussed in light of future challenges.

5.1. ICT and Literacy: Five areas of investment

There are of course many types of investments that can be made in any educational endeavor. And, when literacy and technology are mentioned in the same place, one still hears some policy makers say that the literacy field is so desperately poor that technology would be a 'luxury' that cannot be afforded. We hope to have dispelled the notion that IT is either 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 disaggregate the areas where such investments are likely to make a difference. We suggest the following five areas.

Teacher professional development. The professional development of administrators, directors, teachers, and tutors is an ongoing and critical process for program improvement in literacy, basic and adult education. In adult literacy, volunteer-based programs are an important component in many countries, but the tenure of the typical tutor 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 need to bring the matter of professionalization to the attention of policy makers. There is also a very important need to provide the teacher trainers with new and up-to-date instructional methods. New ICT-based tools can help greatly in this area, as can be seen in the U.S. Already, there exist online distance education courses and materials for teachers. Already, we have seen the self-reinforcing aspect of creating online communities of adult educators working together and supporting one another. These innovations are still uncommon in most industrialized countries, and barely are understood among adult educators in most LDCs. Clearly, there is much that can be done in this area.

Instructional design. Relative to other education areas, little research and development has been done to date in LDCs on improving instructional design for adult literacy in local languages (see the BFI project above, as one counter example). To move the field forward will require a greater emphasis on what works and what doesn’t, with a focus on the poor. Several promising avenues should be promoted in this regard in LDCs. First, institutions of higher education which 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, such institutions, which are already well positioned in the area of Internet access, should become the loci for both receiving and disseminating information that can 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.

Learner motivation. The motivation of learners (whether in or out of school) is a critical factor that either can promote participation and retention, or, when lacking, can lead to poor take up of literacy learning and retention in adult education programs. In contrast to what was thought over recent decades, the challenge of motivation lies in finding ways to provide what the private sector terms, rather simply, "customer service." In order to reach the unreached and the most excluded (e.g., unschooled, women, ethnic-linguistic minorities, rural, and migrants) that are the priority of the U.N. Decade, programs will need to be tailored to address diverse needs, and have direct, discernable outcomes, and incentive-rich experiences. Building learner demand is one of the most pressing challenges in the broad field of literacy, basic and adult education today. Here again, technology can and will play a key role, as it has become one of the most promising ways to engage learners when undertaken in ways that pay attention to the specific needs of varied learners in a timeframe and location that allows for the kind of flexibility that learners often ask for. Meeting learner needs is the best way of enhancing demand and motivation. In LDCs, technology can make a major difference if only by reducing the 'transmission loss' between higher-quality human and material resources (often located in or near large cities) as they make their way to poorer and more rural areas. Bringing high quality multimedia CD-ROMs to the village, for example, is one way to provide much greater material stimulation than the single, tattered primer which is still the tool frequently encountered in rural Africa or South Asia.

Access to technology. A striking aspect of literacy work is its relative isolation in a number of respects. In both developing and industrialized nations, literacy and adult education specialists and practitioners have relatively minimal contact with mainstream specialists in education, and even less with sectors outside of education. Second, even those within the literacy field often have little recourse to opportunities for exchange and cross-fertilization due the general penury of the field itself. Thus, there is an overall need to be connected in many ways, not least of which is to the community of learners, teachers and information resources that could be available to improve literacy work worldwide. No new approach is more obvious than ICTs, with all the potential of low cost anytime/anywhere capability (assuming it can be made available). Naturally, the overall limitations in fiscal and human resources have meant that technology remains far from being implemented in the regions where rates of literacy are the lowest. Clearly, bridging the digital divide in ICT access is part of the puzzle, especially in LDCs, but so is making available the kinds of ICT-based resources that can really make a difference to the poorest of the poor. Community technology centers are an efficient way of making this access available to rural communities. This investment can be particularly significant if these centers are also explicitly charged, provisioned, and trained as community literacy centers, as well.

Development and aggregation of highly useful content. In multiple instances throughout this paper, the paucity of cultural and linguistic digital content has been cited as a serious problem for LDC populations in particular. A significant investment is required to provide such

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. As discussed, 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 that can be added to this shared resource. Naturally, increased Internet connectivity and high bandwidth would strengthen the same argument.

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, such as the following:

Infrastructure and access. This domain, especially from a developing country perspective where resources are in short supply, is one of the most difficult for policy makers. The pressures on where to put hardware and Internet access are tremendous. Further, there is the omnipresent tendency to put such resources into hands that 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 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.

The education system (teachers, content, tools). Policy makers have serious challenges in deciding where to invest scarce resources in terms of teacher training, content development and new ICT tools. While each of these sub-domains is a matter for determination of best practices, from a policy perspective this is also an issue of prioritization. As noted, literacy – especially adult literacy and adult education – have nearly always received lower priority (and fewer resources) than has K-12 education. To turn this situation around will require not only a declaration from the UN (though this will help only in some countries), but rather a realization that adult literacy is a central part of the whole education system. When youth become parents who have children who will likely drop out of school, the impact of adult literacy (and the values

associated with literacy) can be said to have real and direct consequences. 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 negative impact on the potential for ICT inputs into educational improvement. This ratio – like the literacy gap itself – must be narrowed.

Research, policy, and cross-sectoral connections. Technology has the potential to bring disparate people and administrative units (e.g., ministries of education, telecommunications, health, agriculture) together. Yet such varied stakeholders need both solid evidence and good communication to act decisively in any area like literacy. To date, this process has not happened effectively in any country. Still, there is great potential, when deploying ICTs, for different ministries and units within ministries to find common purpose and greater cost-efficiencies, as well as to undertake, jointly, research that will answer some of the kinds of questions raised in this paper. Further, there is considerable potential for helping learners resolve their own issues more efficaciously if ministries could break down some of the barriers that separate activities. To cite just one example: in the BFI project mentioned earlier, the health ministry and the education ministry in Andhra Pradesh, with support from Unicef, 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 program will save both time and resources of the government as well as of the individual learner. Research is also being undertaken on the BFI project that will allow both ministries to judge evidence on effectiveness.

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 that to get them into the village in terms of effective use. As we move into the 21st 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 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 programs 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 much closer to 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 ICT-based programs

that do not pay sufficient attention to the learning, and cultural and attitudinal needs of the individual are likely candidates for failure in the near term and lack of sustainability in the longer term.

6. CONCLUSIONS

The UN Literacy Decade just recently began. Its success will depend on the mobilization of the best talents that can be brought to bear on worldwide literacy problems. In this paper, 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 No Child Left Behind initiatives.

At the same time, if the present paper 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, 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 capabilities (whether in content or in ICT design) are heavily biased toward K-12 education, where the vast majority of national budgets reside; a similar case can be made for teacher training.

In this paper, 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 programs 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.

The paper concludes with a number of implications in the form of principles for action, as follows. Some are intuitive, while others are not.

a. Even in poorest population sectors and countries, ICT is now too cheap to ignore. While once it could be said that ICT would take money away from other lower technologies (such as chalk and blackboards), new approaches can show cost-effective benefits when properly employed.

b. Advanced ICT tools may be relatively *more* cost-effective for the poor than for the rich. It was often thought that old ICTs (such as radio) were necessarily the best route to reaching poor people, while advanced ICTs were only cost-effective for the rich. The example of the cellular phone has dispelled that thought. The Grameen Bank effort in South Asia has

shown that even the poorest people can find value and resources to support a system of cellular communications (World Bank, 1994). A digital camera may be a luxury for those with resources, but it might be a very cost-efficient way of producing digital media in uncommon languages for teaching the poor.

c. Learning technologies must have learning and content at their core. Many of the most egregious mistakes in ICT investments in LDCs concern an overly narrow focus on ICT equipment, without commensurate focus on learning and content (for example, the provision in the 1980s of TV production labs and video libraries when a consistent electrical grid was unavailable, or the present-day efforts of some ICT corporations to 'dump' PCs into countries with insufficient attention to educational utility). Projects within the digital divide must first and foremost be about learning, and about culturally appropriate content.

d. ICT tools must be consumer-oriented and context/culture sensitive. Consumer sensitivity is a longstanding buzzword of marketing in the private sector, yet it seems to be sometimes forgotten in 'supply-side' projects that try to marry ICT and education. Especially when focused on the poor, it is critical to pay very close attention to learner interests and values, which also means ethnic, language, gender, and other cultural and contextual features. Even the Grameen Bank example, mentioned above, is only able to be effectively used by a relatively small number of female village entrepreneurs who are sufficiently skilled to master the commercial and technical aspects of maintaining a mobile phone service.

e. Literacy and technology are becoming inter-dependent, as we have shown in Sections 3 and 4. Literacy and technology are "tools" that have much in common. Neither is an end to 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.

f. Collaboration is not just lip-service in the addressing of digital divide problems for the poorest sectors. Programs with staying power – that will be sustainable – are likely to have to reinforce existing government structures (rather than replace them), and enhance as a priority mainly those areas of public education that are most in need of assistance (e.g., teacher training). Further, institutions of higher education can assist in outcome evaluation and monitoring processes that are at the heart of determining whether further investments are warranted. Similarly, considerably more collaborative research is required in order to promote promising innovations.

g. Private sector involvement in digital divide efforts is essential in order to take advantage of the latest ICT tools (ahead of their release to the public marketplace), and more so than in other educational projects. The private sector can offer advanced knowledge concerning ICT tools that will be soon available, and which will inevitably provide cost-effective and cheap tools over time. Corporate involvement can also provide for a 'pass down' of large numbers

of newly-obsolete PCs, which can be quite serviceable among the poor. There are innumerable examples of such corporate philanthropy in both industrialized and developing countries.

h. In development work, there is much talk about 'sustainability,' which usually refers to the question of how recurrent costs will be covered (for example, by government, external agencies, user fees, etc.). In today's environment, and especially when dealing with the very poor, the concern over sustainability can bias projects in directions that are not necessarily most effective for the end users. There is no single answer to this question, but there is little doubt that the poorest of the poor are unlikely to be able to pay user fees in the same way that the Grameen Bank model of cell phones was able to achieve over the past decade. Commercially viable ICT-based projects — such as fee-driven Internet kiosks — will have some benefits in very poor sectors, but it is unclear whether the poorest people will derive much benefit in the near-term. To be more precise, it is clear that the poorest populations (with few exceptions) have neither the literacy (or ICT literacy) skills, nor the user-fee resources to take advantage of kiosk-like approaches to ICT access. Further, as with most market driven approaches, material development for kiosks will be inevitably biased towards those who have more money to spend, and thus toward the upper end (financially) of even the poorest of communities. Hence, some type of subsidized (non fee-driven) approach will be required for the foreseeable future in such populations.

i. Finally, in order to achieve effective impact in using ICT for the poorest, a dedicated focus will be required on the bottom half of the digital divide population in poor developing countries. At present, it is not unusual to find digital divide initiatives that provide better access to ICTs in universities, secondary schools, and primary schools. However, in a great many of these cases, the recipients are those who are already in the middle or upper classes of their respective societies — this is especially true in developing countries where it is assumed that only middle class communities can make appropriate use of ICT. The challenge is to stay focused on the poor — otherwise the digital gap will simply increase further.

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 – indeed 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.

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