Technology and Social Inclusion

Rethinking the Digital Divide

OA Funding Provided By:

Author

The title-level DOI for this work is:

doi:10.7551/mitpress/6699.001.0001

5
Human Resources: Literacy and Education

Literacy and education affect online access at both the macro and microlevels. At the macrolevel, mass literacy and education serve to grease the wheels of economic development and thus create conditions for greater technologization of society. As Robison and Crenshaw (2000, 8) explain,

> Mass education accelerates this structural [economic] transition by (1) "lubricating" the movement of workers between sectors by providing workers with the necessary cognitive skills and attitudes; and (2) encouraging rapid rural-to-urban migration as literate agricultural workers seek better lives in the city. As a simple extension of this logic, the demand for computers and on-line skills will be driven in part by the degree of education in the population.

Indeed, Robison and Crenshaw found in their large cross-national study that mass education correlated directly with high levels of societal Internet access.

Of course, mass education is not only a cause of economic development but also an effect. The complexity of the relationship is revealed by an important interactional relationship revealed in the Robison and Crenshaw study: The correlation between mass education and societal Internet access is highest in countries that have a large "tertiary" economic sector (based on consumer and producer services, typical of the postindustrial economy).

Education and literacy are also important at the individual microlevel, since reading, writing, and thinking skills remain crucial for being able to use the Internet. Education also helps determine *how* people use the Internet and what benefit they achieve from it. As the Internet becomes more widespread, it is highly likely that its use will be stratified, with some using it principally as an entertainment device and others using it to seek and create new knowledge.[1] The mere existence of the Internet will not create researchers or knowledge seekers out of those without the requisite background or skills.

How, then, can education and literacy best contribute to effective use of information and communication technology, and correspondingly, how can effective use of ICT contribute to education and literacy? To address these questions, I first examine how the Internet is affecting literacy and what new literacies are required for using the Internet. I then look at the broader question of education, analyzing how computers and the Internet are, or are not, transforming learning and teaching.

Technology and Literacy

All human activity is mediated by tools. What is significant about tools is not their own abstract properties but rather how they are incorporated into, and fundamentally alter, human activity. In other words, tools do not simply facilitate action that could have occurred without them, but rather, by being included in the process of behavior, alter the flow and structure of mental functions (Vygotsky 1981). The integration of tool, mental system, and human activity is illustrated nicely in Bateson's discussion of the blind man with a stick (1972, 459):

> Suppose I am a blind man, and I use a stick. I go tap, tap, tap. Where do *I* start? Is my mental system bounded at the handle of the stick? Is it bounded by my skin? Does it start halfway up the stick? Does it start at the tip of the stick? But these are nonsense questions. The stick is a pathway along which transformations of difference are being transmitted. The way to delineate the system is to draw the limiting line in such a way that you do not cut any of these pathways in ways which leave things inexplicable. If what you are trying to explain is a given piece of behavior, such as the locomotion of the blind man, then, for this purpose, you will need the street, the stick, the man.

The tools of literacy include language itself as well as a wide variety of physical artifacts, such as the papyrus, codex, book, pencil, pen, paper, or typewriter. The development of each of these tools has had a profound effect on the practice of literacy.

Today, social, economic, and technological transformations are again aligned to bring about major changes in literacy practices. New types of computer- and Internet-based literacy practices are emerging that I have referred to previously as electronic literacies (Warschauer 1999; see also Shetzer and Warschauer 2000). Electronic literacies are not isolated from the types of literacy practiced with print but rather involve added layers that account for the new possibilities presented in the electronic medium of computers and the Internet (Buzato 2001; Selfe 1990). Electronic literacy is actually an umbrella term that encompasses several other generic literacies of the information era, including computer literacy, information literacy, multimedia literacy, and computer-mediated communication literacy. These new literacies stem in part from the new technological features of the computer but also from the broader social setting in which computers are used.

Computer Literacy

The term *computer literacy* emerged in the early 1980s together with the spread of the personal computer.[2] Within a decade, the term had become widely discredited among educators because it generally referred to only the most basic forms of computer operation, such as turning on a computer, opening a folder, and saving a file, and thus tended to justify a very limited view of computer-related education. While the criticisms of computer literacy as an end in itself are certainly merited, there does exist a fluency (or, alternatively, unfamiliarity and discomfort) with the physical and operational manipulation of a computer that profoundly affects people's productivity with it and that intersects with a range of social dimensions, such as age.

Consider, for example, the kinds of computer literacy involved in browsing or searching the Internet (which overlap with information literacy, see next section). Hargittai (2000b) conducted an extensive observational and interview study of a randomly selected Internet user population from the general public in New Jersey. She found that some people had little awareness of the Back button, a button ordinarily used in 30% of people's browsing activities (Tauscher and Greenberg 1997), which severely hindered their ability to navigate the Web. Many people had a difficult time entering valid search terms in large part because of spelling errors. Other users insisted on putting search terms together without any spaces (e.g., MichaelJordanbasketball) , mistakenly extrapolating from the fact that URLs cannot include spaces. And others rarely used search engines at all, relying solely on functions of their browsers or Internet service providers.

An example of the value of computer literacy is offered by the renowned Colombian author, Gabriel García Márquez, who has described how his own productivity has multiplied greatly through his writing on computer (Day and Miller 1990). In García Márquez's case, this need not have involved much more than the use of word-processing software and manipulation of the mouse and keyboard. For García Márquez—a perfectionist who in precomputer days would copy and recopy a page to correct a typing error—computer literacy greatly increased the speed with which he could write and produce manuscripts, and thus dramatically increased his literary output. It also allowed him to transform his method of writing from one that involved perfecting one page a day to working on longer sections in an integrated manner. Did the computer make García Márquez a *better* writer, however? Perhaps it is as difficult—and meaningless—to answer that as to answer whether the cane in the previous example made the blind man more perceptive. Let's just say that the activity of *García Márquez* + *computer* + *writing* is a different activity than *García Márquez* + *typewriter* + *writing*, involving a different writing process and increased productivity.

It is also clear that *García Márquez* + *computer* – *writing* would be an entirely different activity altogether; it is the author's skill as a writer that allows computer literacy to add so much value. In educational settings, one common problem is too much emphasis on basic computer literacy in isolation from broader skills of composition, research, or analysis. Without reference to meaningful content, goals, purposes, or tasks, computer literacy adds little value to learning. As Neil Postman (1993) put it, there are "no 'great computerers,' as there are great writers, painters, or musicians." Or, as Michael Bellino, another critic of school computing, argued, "Tools come and tools go. . . . The purpose of schools is to teach carpentry, not hammer" (quoted in Oppenheimer 1997, 62). However, just as hammering should not be taught without reference to carpentry, carpentry cannot be mastered without learning how to hold and wield a hammer properly. Similarly, comfort and fluency with hardware, software, and operating systems are not ends in themselves but are important components of broader learning goals and should be treated as such.

Information Literacy

The value of information literacy stems not just from the development of the computer and the Internet but also from a broader information society. The difficulty and importance of managing the rapidly expanding amount of information of the modern era was recognized more than a half century ago by Vannevar Bush (see chapter 1). Bush's dream to hyperlink information sources was eventually realized in a format he never imagined with the creation of the World Wide Web in the 1990s. The development of the World Wide Web, together with a host of other public and commercial online databases, enabled unprecedented personal access to information around the world—but only to those who have physical access to new technologies and the appropriate information literacies.

The skills and understandings involved in using ICT to locate, evaluate, and use information include being able to

- Develop good research questions
- Determine the most likely places to seek relevant information
- Select the most appropriate search tool
- Formulate appropriate search queries
- Rapidly evaluate the result of a search query, including the reliability, authorship, and currency of a source
- Save and archive located information
- Cite or refer to located information (See further discussion of these points in Shetzer and Warschauer 2000.)

Information literacies involve both computer-specific knowledge (e.g., mastery of browsing software and search tools) and broader critical literacy skills (e.g., analysis and evaluation of information sources).

Many of these broader critical skills were also important in the pre-Internet era, but they take on greater importance now with such vast amounts of information available online, much of it of questionable quality. Burbules and Callister (2000, 96) point out four types of troublesome online content, which they label "the 4 M's". These include *misinformation* that is false, out-of-date, or incomplete in a misleading way; *malinformation* that some will consider "bad," such as bomb-making instructions, degrading images, or other information that promotes hatred or violence; *messed-up information* that is poorly organized and presented to the point where it is not really usable; and *mostly useless information*, which is of course abundant on the Web. All these types of troublesome information exist in other media as well, but the Web presents particular perils (as well as promises) because of its lack of gatekeepers.

Consider, for example, the difference between a student research assignment before the Internet was available and today. Earlier, a high school student would gather information for a paper by checking books out of the school library. These books would have been vetted twice: once by the publisher and once by the librarian who purchased the books. With the reliability of the books' contents thus established, the work of the student was largely limited to collecting and summarizing information from a variety of library sources.

Today, a student who relies at least in part on information collected from the Internet has a much greater personal responsibility to critically evaluate sources because of the unevenness of quality and reliability of texts found there. Indeed, it is impossible to even navigate or search the Internet without making very rapid judgments as to the reliability of various sources of information. A reader must decide on the spot whether to pursue information on a particular page, follow links to other sites, or return to a search engine for another try. In such a circumstance, it makes little sense to discuss critical literacy as a separate or special construct; rather, critical literacy is an essential element of reading in the online era.[3] And, as Burbules and Callister (2000) point out, critical reading of the Web involves analyzing whether a site is credible, examining its viewpoint, asking why information is presented in a particular fashion, considering what kinds of information are left out of the presentation, and determining whose interests are served by the site's emphasis, organization, or omissions.

There is a vast difference between information and knowledge, and information literacy is crucial for being able to transform the former into the latter. Such literacy is distributed unequally in society (Hargittai 2002a) and intersects with other forms of social stratification. Promoting information literacy should be an important goal for projects seeking to promote social inclusion.

Multimedia Literacy

In the past, literacy chiefly meant text-based literacy. That is because the main technologies of literacy, such as the printing press, have "privileged the written language over all other forms of semiosis" (Kaplan 1995, 15), thus separating verbal from iconographic information and representation.

But human beings have a desire for what Jay David Bolter has called "the natural sign" (Bolter 1996, 264). As Bolter explains, "Pictures or moving pictures seem to have a natural correspondence to what they depict. They can satisfy more effectively than prose the desire to cut through to a 'natural' representation that is not a representation at all" (265–266). This desire for the natural sign—partially suppressed by the limitations of print—has expressed itself widely throughout the twentieth century in the popularity of film and television, and in recent developments in newspapers, magazines, and books. Kress (1998; Kress and van Leeuwen 1996) illustrates nicely how both newspapers and textbooks have dramatically altered in format in recent years, with visual images becoming increasingly prominent.

It is in the realm of computers, however, that multimodal communication has progressed the furthest, combining text, backgrounds, photos, graphics, audio, and video in a single presentation. The falling cost of computers and multimedia software means that millions of people around the world have the desktop power—if not necessarily the skill—to create multimedia documents, ranging from simple PowerPoint presentations to homemade movies.

This reemergence of the "natural sign" has profound implications for digital democracy. The domination of writing over other forms of semiosis has long contributed to social inequality. Learning to read and write takes years of schooling, and the gap between the schooled/literate and the unschooled/illiterate (whether at the individual, village, or societal level) has intersected with, and contributed to, almost all other socioeconomic divides of the last five hundred years. Text literacy also privileges the few dozen dominant written languages of the world (many with colonial histories, such as English, Spanish, and French) at the expense of indigenous languages, many of which lack a written form or suffer from a paucity of published material. Finally, the social practices of text literacy in schools—decontextualized, individual study and memorization rather than collective creation and interpretation—have further marginalized nonelite groups throughout the world, including many tribal and indigenous peoples whose traditional methods of learning focus on shared storytelling using audiovisual elements such as song, chanting, and dance (Warschauer 1999). For all these reasons, the rise of multimedia should provide an important opportunity to level the playing field of literacy by restoring the status of more natural forms of audiovisual communication that are in some ways more broadly accessible.

However, in other ways, the economics of the information technology industry and the social stratification of educational systems make multimedia creation highly *inaccessible* to the masses. While the cost of computers and Internet access continues to fall, the cost of the hardware, software, and bandwidth necessary to create the newest forms of multimedia remains more expensive. Stratified access to more powerful multimedia computers thus parallels other types of income and educational stratification discussed earlier in this book (see Becker 2000). In addition, in the United States and many other countries, unequal educational systems mean that students in wealthier communities get more frequent opportunities to create sophisticated multimedia whereas low-income students often are relegated to using computers for remedial drills and exercises (Becker 2000; Wenglinsky 1998). As a result, the potential of multimedia as a force for social equality can be turned into its opposite, with some sectors of the population learning how to become the producers of tomorrow's multimedia content while others are prepared only to be passive recipients (see Castells 2000b; Warschauer 1999). This discrepancy between the *potential* of multimedia literacy in promoting social inclusion and the unequal *access* to the tools and practices of multimedia literacy deserves attention.

Computer-Mediated Communication Literacy

Computer literacy, information literacy, and multimedia literacy have been widely noted and discussed by others. Computer-mediated communication (CMC) literacy has not received as much attention. CMC literacy refers to the interpretative and writing skills necessary to communicate effectively via online media. At a simple level, this includes the "netiquette" of polite online communication. At a more advanced level, it includes the pragmatics of effective argumentation and persuasion in various sorts of Internet media (e.g., e-mail, Web-based bulletin boards). At the most advanced level, CMC literacy includes knowing how to establish and manage online communications for the benefits of groups of people (e.g., community organizations running their own discussion or training sessions online).

Much basic CMC communication skill is learned implicitly and needs no instruction; an hour or two in a chat room, and a teenager will begin to pick up the style of interaction used most in that particular online space. However, it would be a mistake to infer from this that CMC literacy is developed spontaneously through social interaction or that CMC is not important since it partly revolves around chat. Indeed, in recent years, CMC has become a potent form of business (American Management Association, cited in Warschauer 2000a) and academic communication (Agre 2001b), and its more sophisticated forms are not as easy to learn. In this light, it is useful to consider the distinction made by Jim Cummins (1984) between Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALP) in relation to immigrant students to the United States and Canada. Cummins pointed out that even though immigrant children learn conversational skills in English by means of informal chatting on the playground, they still lack mastery (and need instruction in) more cognitively challenging uses of their new language, such as reading and writing academic papers, even long after they are speaking English fluently. In the same ways, the fact that children know how to chat on a computer does not mean they know how to write an effective e-mail message to a business organization, academic institution, or political representative.

The importance of CMC literacy can be illustrated through an example from academia. One important international divide in any consideration of new technologies and people's access to them concerns control of research—with academics in developed countries often usurping authorship rights of research partners in developing countries. In this particular example (Warschauer 1999), a Chinese researcher working in Shanghai had carried out much of the ground research in a study on community public health and had had prior agreement from the other research team members that a certain part of the research data would be under his control. In contrast to this agreement, though, his two Swedish colleagues e-mailed him and informed him that they were going to publish the research only under their own names. The Chinese researcher had no idea of how to write an effective e-mail message protesting this situation, and following norms of oral communication common in China, he wrote a draft of an e-mail that addressed the issue only in the most circular fashion: first devoting a lengthy introductory paragraph to discussing the health of his Swedish colleague's mother. Fortunately, that e-mail message—which, by failing to adequately reply to the Swedes' authorship proposal, could have cost him his authorship rights—was never sent. After much discussion and intervention from some American colleagues to whom he showed the draft of his e-mail message, the Chinese researcher was able to rewrite the message in a much more direct and effective manner. The Swedish colleagues were persuaded to yield and included him as author on the paper.

This last example illustrates how electronic literacy involves far more than being able to operate a computer. Rather, it is an act of agency: "the power to construct a representation of reality, a writing of history, and to impose reception of it by others" (Kramsch, A'Ness, and Lam 2000, 97). Its practice involves not only the individual activity of decoding and encoding text but also the social activity of exercising control. Like other forms of literacy, it entails not only reading the *word* but also reading the *world* and, in a sense, writing and rewriting the world (Freire and Macedo 1987).

The mere physical presence of computers will not guarantee that these important literacies are mastered. They will most often be learned in educational settings—which is the focus of the following section. First, I briefly examine general educational theory and then, with this as a backdrop, specifically look at the role of technology in education.

The Social Life of Education

Educational debate in the United States and many other countries has been dominated by two schools of thought. The first of these views education as a transmission process. The second of these views education as a constructivist process. Both, however, downplay the social aspect of education, and it is that aspect that is particularly relevant in evaluating the potential impact of ICT on learning.

A transmission perspective considers education as the acquisition of facts, information, skills, and knowledge through a regime of lecture and tutoring (a process derogatorily referred to as "the filling of a pail"). It is the perspective behind E. D. Hirsch's widely cited book *Cultural Literacy* (1987) and his subsequent series of books listing the exact facts that students at each grade level in the United States should know. It is an approach that is clearly at odds with the imperatives of an information age, in which the memorizing of facts that our grandparents knew is much less relevant than one's ability to construct and communicate new knowledge from a wide variety of data sources (Bolter 1991). A transmission approach can be supported by technology, but only in its narrowest uses, as illustrated by an anecdote about the veteran teacher who boasted:

> Don't tell me about educational technology. I've been using it for decades. In fact, I have all my lecture notes written down on a huge rolled transparency. Every year, I stand in front of the class and just roll the transparency, and the students copy down the information in their notes. And that's how I can tell how well the class is going. The faster I can roll, the better it's going.

The commonly posted alternative to the transmission perspective is a constructivist approach to education. Based on the ideas of Jean Piaget (1970), constructivism views learning as an internal mental process based on an individual's discovery of external phenomena. Constructivists seek to foster opportunities for exploratory learning and the development of mental models of how things work or are accomplished. Constructivists are strong supporters of educational technology (see Schank and Cleary

1995), especially through the use of computer programming to promote discovery learning (Papert 1980). In fact, though, these types of constructivist learning activities—such as using a programming language (e.g., Logo) to design on-screen representations or to control Lego toys—involve a great deal of social interaction, so while constructivism is obviously an improvement over transmission perspectives, it too can benefit from the types of social perspectives on learning discussed here.

Theoretical opposition to the transmission and constructivist approaches colors many of the educational debates taking place in the United States and other countries at present. A prominent example of this is the overhyped battle between advocates of *phonics* and *whole language* for reading instruction. Supporters of phonics see reading as emerging from the memorization of dozens of rules about how individual letters are sounded out. According to this perspective, these rules need to be transmitted to learners in order for learners to become fluent readers and writers. Whole language advocates, on the other hand, see reading as an emergent psychological process based on children's discovery of meaning. Similar struggles are taking place over issues related to spelling (Shall learners' mistakes always be tolerated?), writing (the following of rules or the discovery of voice), mathematics (the memorization of rules or their discovery), and science (memorization versus experimentation). Unfortunately, these debates often obscure, rather than shed light on, the actual processes by which learning takes place. In particular, the transmission and constructivist approaches both fail to fully value the social factors that are at the heart of learning and education. These social factors take place at both a microlevel of communities of practice and a macrolevel of social reproduction.

Communities of Practice

Learning is as much about enculturation as it is about transmission or discovery (e.g., Lave 1988; Ochs and Shieffelin 1984). To begin with, almost all human learning takes place within *communities of practice* (Lave and Wenger 1991). Communities of practice are networks of people who engage in similar activities and learn from each other in the process. Sometimes communities of practice are found in formal learning structures, such as classes and schools. More frequently, they are grounded in informal networks such as families or professional or occupational groups, and in social circles that occur in social contexts such as work or sports.

Learning in communities takes place through a process of apprenticeship. This occurs at every level from the most basic (e.g., a child learning to walk or talk) to the most advanced (e.g., a medical internship or doctoral program). Some of the learning that occurs by means of apprenticeship is via direct instruction, for example, when a coach shows a player the right way to shoot a basketball. Much more of this learning—even in formal educational settings—occurs informally or incidentally, as learners and experts observe, imitate, experiment, model, appropriate, and provide and receive feedback. In short, an ideal learning situation provides the kind of scaffolding needed for apprenticeship learning to take place in a safe, supported way. This scaffolding might include the provision of models and resources, the organizing of learning activities in desirable sequences, and the use of conversation and discussion to tackle difficult questions.

Apprenticeship often occurs through a mentoring process with a teacher or a more capable peer. Lev Vygotsky (1978) has described this type of learning in terms of a zone of proximal development (ZPD). The ZPD is the distance between what a learner can accomplish by himself or herself compared to what he or she can do with the assistance of others; a learner advances through this ZPD by gradually taking on tasks alone that he or she previously could accomplish only with expert assistance. However, the involvement of an expert or mentor is not a necessary requirement for apprenticeship learning to take place. Informal networking among peers is also a valuable source of learning, and often more powerful than direct instruction. Learning situations that provide for a good deal of informal peer networking maximize people's opportunities to learn; situations that exclude this kind of informal networking can endanger the learning process. This principle has a good deal of importance in relation to new technologies; consider, for example, how relatively easy it is to learn a new computer program while working in an office or other environment where others already are using it (and thus can provide ready feedback and assistance) compared to how difficult it is to learn a new computer program by oneself at home.

Why are communities of practice so important? First, because the most valuable learning in society involves not so much *learning about* as *learning how* (Brown and Duguid 2000). An excellent example of this is found in writing. One learns to write not by memorizing facts about writing but by engaging in the social practice of writing in the company of colleagues, peers, critics, and mentors. Learning how to write involves appropriating the language of others, reproducing examples of writing that one reads, responding to questions and suggestions, and receiving and considering the guidance of expert critics—a classroom teacher, a dissertation committee, or the peer reviewers for an academic journal. Learning *about* writing might take place in a few days by reading a book; learning *how* to write takes many years of engagement in communities of writers.

Equally important, *learning how* is intimately tied up with *learning to be*, in other words developing the disposition, demeanor, outlook, and identity of the practitioners. This is obvious at the most advanced level of learning in universities. For example, learning how to conduct scientific research inevitably involves learning how to think, act, and interact as a research scientist. It is also true at the most basic level. For example, a study of computer users at community technology centers in California found that identity formation was a critical component of learning how to use a computer (Stanley 2001). Many of the study participants who owned home computers admitted they had never used them, partly out of fear and lack of knowledge but also because of their own self-concept. They simply didn't see themselves as the type of people who used computers. As one person noted, "I thought [computers] were too much to dream about; like a dream that is too far from reality. I couldn't see myself as someone who uses computers. I thought they were for smart people or college students" (17). Fully 70% of the interviewees in this study mentioned similar self-concept or identity issues related to computers. Only after coming to a community technology center did they begin to change their self-perception of themselves as computer nonusers. For these learners—and for so many others—effective learning involved not only a mastery of skills but also joining a community of practitioners.

Social Reproduction

Social context plays an important role in how educational institutions and processes are structured, not only at the microlevel of community interaction but also at the macrolevel. The key concept here is social reproduction; in other words, educational institutions are structured in ways that reflect and contribute to the broader social, economic, politic, and cultural relationships (Bowles and Gintis 1976; Willis 1977).

The most interesting research pertaining to social reproduction and educational technology has been conducted by Larry Cuban. Cuban's (1993) ninety-year history of educational practices demonstrated that U.S. schooling is highly resistant to reform, as teachers' behaviors are constrained in numerous ways by societal norms and expectations. Meaningful reforms that do take place in U.S. schools almost always benefit the most economically privileged students, who are deemed suitable of engaging in critical and reflecting learning. Reforms in low-socioeconomic schools generally take place on the margins of the educational process and fail to seriously transform the learning process. Cuban (1986) conducted a parallel historical study that examined uses of educational technology since 1920, including radio, television, and film. He found that technology was frequently imposed by outside parties—especially self-interested technology businesses—and had little impact on reshaping education, which responded instead to broader socioeconomic imperatives. Cuban's (2001) latest study on educational computing has found similar dynamics, with educational institutions still highly resistant to reform despite infusion of new technology into schools and classrooms. The requirements to cover curriculum, to prepare students for standardized tests, to change classes at fifty-minute intervals, and to maintain discipline and order make it difficult for teachers to engage in creative technology projects with students, except in elite schools that generally have better and more flexible teaching conditions.

Situated Learning and Critical Pedagogy

How then is a social approach to education translated into classroom practices? To accomplish this, two socially based models of teaching and learning are required: situated learning and critical pedagogy. Situated learning has two main focuses. The first is on assisting students to become part of learning communities. As Brown, Collins, and Duguid (1989, 33) explain, "To learn to use tools as practitioners use them, a student, like an apprentice, must enter that community and its culture. Thus in a significant way, learning is . . . a process of enculturation." The second emphasis is on creating relevant situations by providing students with opportunities to "carry out meaningful tasks and solve meaningful problems in an environment that reflects their own personal interests as well as the multiple purposes to which their knowledge will be put in the future" (Collins, Brown, and Newman 1989, 487). These focuses are interrelated. For example, a high school science teacher should facilitate students' entry into the community and culture of scientists by providing students with similar kinds of tasks—formulating real questions, gathering and analyzing data, developing interpretations—that they might later engage in as researchers.

Critical pedagogy shares much with conceptions of situated learning but also emphasizes the role of learners themselves in defining their own problems based on social needs and issues facing their families, communities, and others, and on confronting these problems through collective inquiry, critique, and action as part of the educational process (Freire 1994). Learners can thus confront—or at the very least, make explicit—the problem of social reproduction by analyzing, critiquing, and challenging unequal power structures as part of their learning process in school. Cummins and Sayers (1990; 1995), for example, adopted this approach to Internet-enhanced learning by promoting long-distance partnerships to identify and address important social issues as defined by learners; an example of this kind of project is discussed in the section on Project Fresa later in this chapter.

ICT in Education

The concepts of situated learning and critical pedagogy are invaluable for understanding the relationship of ICT to education, particularly when considering programs that seek to promote social inclusion for marginalized groups. Technology assists learners the most when it is not the sole or even the main focus of teaching and learning. An overemphasis on the computer per se leads to the most basic kinds of computer literacy instruction where the students may learn little more than how to make, save, and access document files. But by using the computer and the Internet to help learners enter new communities and cultures, tackle meaningful problems, and address situations of social inequity, educators can help students master the broad range of literacies required for the information age. This principle is seen in three different types of programs: computer education, computer-enhanced education, and distance education.

Computer Education

A primary means of promoting ICT access is through computer education. Community technology centers in both developed and developing countries have set up educational programs to empower socially marginalized people to learn how to use computers. Even though the computer itself is ostensibly the topic of instruction, these programs are most effective when they link with broader purposes and functions. Examples of this are seen in the work of the international Committee for Democratization of Information, based in Brazil, and the Playing2Win Community Technology Center in New York.

Committee for Democratization of Information The Committee for Democratization of Information (Comitê para Democratização Informática—CDI)[4] is one of the largest and most successful grassroots organizations in the world directly promoting social inclusion with technology. Founded in 1995, CDI is based on the principle that the ability to use computers is central to full economic, political, and social participation in today's world. To further public knowledge of computing, it has established more than 325 community-based educational centers in nineteen states in Brazil, with a few additional centers in Uruguay, Chile, Colombia, Mexico, and Japan.

These educational centers have been established through extensive public-private partnerships. In most cases, preexisting community organizations provide the facilities and management of the center, and donations for the hardware and software are sought from the private sector (e.g., information technology firms, chambers of commerce). Teachers who work in the centers are usually chosen from the community itself, with the main criteria being social commitment rather than computer expertise (since the latter can be achieved through training).

There are many similar projects throughout the world, albeit on a smaller scale. What is special about CDI and accounts for a good deal of its success is its innovative approach to computer education. In line with situated learning and critical pedagogy, CDI does not see learning computers as an end in itself. Rather, it has worked to integrate computer education into broader social issues of concern to the communities that it serves. The general umbrella theme for this work is that of citizens' rights.

The centers established by CDI are called Schools for Information Technology and Citizens' Rights (Escolas de Informática e Cidadania—EIC). These schools have two target audiences: the poor and the socially marginalized, such as prisoners, people with AIDS, street children, indigenous communities, and landless movement members. The broad theme of citizens' rights is adapted by the local teachers and learners according to the special concerns of the particular community in which the school is located. Computer skills become the backdrop to this process rather than the main focus. Members of a landless movement, for example, may learn Microsoft Word while developing flyers, brochures, and other materials to serve their own mobilizing campaigns. A neighborhood group may learn how to use PowerPoint software by developing presentations addressing themes of drugs, sexuality, crime, and other social problems confronting the community. An indigenous community might learn how to use a database program through archiving and organizing a list of vital community resources.

I visited several CDI schools in Brazil in August 2000. At the Monte Azul Community Association complex in one of the poorest *favelas* of São Paulo, an EIC had been established to assist the economic development of the community. All the participants in the EIC were teenagers or young adults who were also engaged in other community workshops related to work force development (e.g., woodworking, electronics, paper production, weaving, doll making). In the EIC the participants carried out projects related to this other vocational training, such as developing designs for the paper products they were printing. A second

EIC that I visited was at the "FEBEM" Youth Prison, and the curriculum here dealt more directly with social issues (rather than work skills), especially those of particular importance to the incarcerated youth, such as the roots of crime, the social challenges that confronted the youth, and their chances for rehabilitation upon release. They engaged in a wide range of discussion and computer-based writing activities on these themes, and produced a twelve-page tabloid newspaper of their writings and designs. This newspaper included articles such as "Misery and Poverty," "Say No to Drugs," "Life Is not Easy," and "Liberty Is not Given by the Oppressor, but Conquered by the Oppressed." Throughout these activities, the students learned to use programs such as Microsoft Windows, Microsoft Word, and Microsoft Paint, even though the software programs themselves were not the main target of instruction. And during interviews I conducted with EIC students, the participants spoke highly of both the computer skills they had gained and the broader social perspectives they had developed.

Playing2Win Playing2Win (P2W),[5] founded in Harlem in 1983, is the oldest community technology center (CTC) in the United States P2W not only has a major presence in Harlem but has also provided two decades of leadership for many national initiatives, including the Community Technology Centers Network (CTCNet, a coordinating body of more than 500 independent CTCs in the United States).

While P2W offers a few traditional technology courses, such as Computers and the Internet—Beginners or Office Skills: Microsoft Suite, about half its adult classes and all its youth classes are based on themes and projects rather than on specific computer applications. The goal for the center, according to P2W director Rahsaan Harris, is to allow the people of Harlem to develop sophisticated multimedia skills while engaging in projects that are of social and economic significance to the participants and the community.

For example, one course offered as part of a summer youth program is called Portraits of Harlem. Participants plan and produce professional postcards and posters based on modern or historical images of Harlem. Technical skills involved in this project include taking pictures with a digital camera, transforming old photographs to digital form using a scanner, and touching up images and creating final products with a graphics editor. Business skills are also covered in this course, including how to market, promote, and advertise a product; how to find customers; and how to determine best pricing levels in order to achieve maximum profit. Artistic skills are, of course, also honed during the life of the course, and include designing the postcards or posters as well as identifying what aspects of Harlem life are of artistic and social concern to the broader community. Ties across generations are encouraged through inclusion of old family photographs belonging to participants or their families that are judged by the group to have artistic or social value.

In another course conducted regularly by P2W, entitled Web Design Studio, participants work in teams to design Web sites for local community businesses. Technical skills such as using advanced photoediting or Web page markup software are combined with broader processes such as interviewing a client, communicating with an audience, and evaluating a final product. The project serves the participants, who develop a range of marketable skills and abilities, as well as the broader Harlem community through the development of e-commerce sites for local small businesses that would otherwise be unable to pay for the development of their own Web sites.

A third popular P2W course is called Digital College Portfolio. This is geared toward lending a helping hand to high school juniors and seniors seeking to enter university or the job market. Participants learn to create an electronic portfolio with copies of their original drawings, writings, photographs, music, video clips, and cartoons. At the same time, they learn to create and manage a Web site while also familiarizing themselves with the college application and essay-writing process.

Other courses include Eco-Science, in which students use digital cameras, photoediting software, and office suite applications to document what they see during field trips to local parks; She-Thang, in which young girls create a Web site with articles on young women of color, memoirs, poetry, editorials, and media reviews (published on the HarlemLive Web site; see chapter 4); and Percussion Digital Music, in which participants learn how to digitize music by means of recording, processing, and mastering while acquiring basic proficiency in audio processing and arrangement/layout.

The pedagogy in all these courses is deliberately student-centered and project-based. This does not mean that participants are left to their own devices; rather, the instructors, guest lecturers, and, at times, more advanced students provide guidance in and assistance with technical skills and processes at the point of need.

Computer-Enhanced Education

Groups like CDI and Playing2Win were established in order to provide computer skills to low-income and marginalized communities. These organizations then developed, and continually adapt, a curriculum that they felt could best combine computer skills with other content that served community needs.

Computer-enhanced education starts from a very different premise. In computer-enhanced education, a broader curriculum is already established, based on courses and content in areas such as mathematics, science, social studies, and language arts. The challenge there is not to create an entirely new curriculum but to make effective use of technology to enhance broader educational purposes.

The main site of computer-enhanced education is public schools and colleges throughout the world. These educational systems, with hundreds of millions of students, represent a critical arena for combating marginalization from the information society. If public schools help compensate for unequal access to computers at home, they can provide an important means for promoting social inclusion and equality. If, on the other hand, schools offer unequal access to and use of technology, this can serve to heighten social stratification.

Computers in U.S. Schools In developed countries, educational use of computers has the potential to either help overcome or worsen social stratification. On the one hand, technology can be an equalizing force, by giving all students access to a tool/medium that is vital for today's education. On the other hand, if technological resources are unequally distributed or used in schools, ICT can serve to stratify already existing inequalities.

The United States is the country with perhaps the longest and most extensive use of computers in education; nevertheless, the results to date are not encouraging. Evidence suggests that the use of computers in education is tending to worsen rather than help overcome societal inequality.

There is differential physical access to computers and the Internet in schools in relation to income and race. According to data gathered by Market Data Retrieval, schools in high-poverty communities in the United States have one computer for every 5.3 students compared with a ratio of 4.9 in low-poverty communities ("Dividing Lines" 2001). The difference is even greater at the level of Internet access: high-poverty schools have a ratio of 9 students to 1 computer with Internet access compared with a ration of 6 to 1 in low-poverty schools. At the economic extremes, the differential is still greater (Cattagni and Westat 2001). Or, to put it another way, according to the Department of Education, in schools that have fewer than 11% of students living in poverty, 74% of classrooms have Internet access ("Dividing Lines" 2001). On the other hand, in schools with 71% percent or more of students who are poor, only 39% of classrooms are connected to the Internet.

Differential access *across* schools is multiplied by differential access *within* schools. In a study of 185 primary, middle school and high school teachers in an urban school district, Janet Schofield and Ann Davidson (2000) found that some 25% of the teachers engaged in Internet activities primarily or exclusively with academically advanced students, but only 5% carried out Internet activities primarily or exclusively with lower-achieving students. And the differential access continues at the *within-class* level. A full 70% of the teachers in the Schofield and Davidson study only allowed some (rather than all) of their students to use the Internet, with the privilege usually reserved for those who were already performing well academically or behaving especially well. Internet use in the schools involved in the study appeared to be regarded by teachers as a reward or special privilege for model students.

Of course, much more important than the actual amount of time that students spend on computers and the Internet is what they actually do there. Here the evidence is especially discouraging. Basically, a disproportionate number of poor and Black or Hispanic students are engaged

Table 5.1
Primary Computer Uses by U.S. Eighth-Grade Students (as Reported by Their Teachers)

	Simulations/Applications (%)	Drills/Practices (%)
U.S.	27	34
Asian	43	27
White	31	30
Hispanic	25	34
Black	14	52
High income[a]	33	31
Low income[a]	22	34
Private school	30	10
Public school	27	36

Source: Adapted from Wenglinksy (1998).
[a] High income and low income determined by eligibility for subsidized school lunch.

by their teachers in using computers for remedial drills, while well-to-do and White or Asian students significantly more often use computers for applications and simulations promoting higher order thinking (table 5.1).

Paradoxically, it seems that because of the popularity of remedial drill-and-practice (more pejoratively known as drill-and-kill) software, low socioeconomic status (SES) students often end up using computers in classrooms more than high SES students, at least in middle and high school settings. For example, a national survey by Henry Becker (2000) showed that in English and mathematics—the two subject areas in which remedial software appears to be most popular—low SES students are reported as using computers more frequently than high SES students. In science, a subject in which many computer-based simulations and other advanced applications are available, computer use is reported as being greatest among high SES students.

Recently, over the course of an academic year, I conducted observations and interviews on a regular basis in two high schools in Hawai'i: one was an elite, expensive private school in a well-to-do neighborhood, and one was a rural public school in an impoverished community

(Warschauer 2000b). Students in the former were principally white or Asian-American from middle-class or wealthy families. Students in the latter were overwhelmingly native Hawaiian or Pacific Islanders (e.g., Filipino, Samoan) from low-income families. Both of the schools had a reputation for making excellent use of educational technology and were in fact selected for the study for that very reason.

Interestingly, both of the schools had engaged in the kinds of reform that are portrayed as critical to effective use of technology (see Means 1994; Sandholtz, Ringstaff, and Dwyer 1997). These reforms served to devolve more power and authority to students and to move away from the kind of lock-step teacher-centered instruction that is often criticized. For example, both schools used a good deal of student-centered project-based work, especially in the technology-intensive courses. Both schools allowed for flexible scheduling, so that students could sometimes meet for two or more hours in a block of time rather than only in fifty-minute periods. And both schools made use of interdisciplinary team teaching, so that subject teachers across disciplines could work together to help coordinate interesting projects.

In spite of the extensive use of technology at the two schools—and the common reforms that in theory should have allowed technology use to be effective—the ends to which computers were put were markedly different when the two schools were compared. Simply, regardless of the subject area, the elite school used technology to help prepare scholars, whereas the poorer school used technology to help prepare people for the work force.

To provide an example, students in a biology class at the elite school used hand-held devices to probe the temperature, acidity, and absorption spectra of plant life in nearby ponds, downloaded the data to personal computers, and then used a software program to graph, compare, and interpret the data. This project was team-taught by the biology and the math teacher so that the students could learn to make better use of calculus algorithms in their data analysis. In contrast, students in a marine biology class at the poorer school used computers to edit a newsletter about their personal experiences with marine biology, discussing, for example, their personal feelings about a class trip around the island of O'ahu. The students also wrote and compiled inspirational stories from their own lives and produced their own local version of the well-known book *Chicken Soup for the Soul* (Canfield and Hansen 1993). These activities were unquestionably educational, and certainly involved computers and a range of applications, but they did not focus on the discipline of science per se, as was the case in the wealthy school. Perhaps even more telling, instead of the team-teaching partnering involving biology and math, in the low SES school the biology and business teachers collaborated on projects. The former partnership was designed to strengthen students' skill in analysis of complex biological phenomena whereas the latter pairing emphasized the vocational aspects of the course.

The teachers involved in these two classes were quite explicit about the different goals of their instruction. The biology teacher at the elite school—a former research scientist at Stanford—explained how he deliberately geared all his in-class activities, including computer work, toward helping students develop the research skills necessary to enter college. As he explained,

> We've been working over the years on our biology program, particularly our advanced biology program, to give students the type of experience that they need to prepare them for college work. So I have a very strong background in research, which I loved. And I try to share that love of research with my students. And since I was pretty much lab oriented and biochemistry oriented, I did what I knew and tried to implement those kinds of experiments. And it became obvious, over the last ten years, that computers were becoming one of the most important scientific tools available. And, so we wanted to implement the computers into the program. We realized that this was an important scientific direction for our students to go.

In contrast, the science teacher at the poorer school, who was not herself a science major, saw her goal as helping prepare her students for employment:

> I looked at these kids and I said, how many of them are going into a science-related field? Out of fifty, it's lucky if three or four of them would go into something science-related. So I said, this is really not acceptable. And that's where I changed my focus. As far as I'm concerned they don't have to learn the science or learn the material, as long as they're doing these projects. But my focus is on them being respectful, responsible, and seekers of information. And I said, then I don't care what you do, whether you go out and be a trash collector or dig ditches or if you go into a community college.

The teacher justified her approach by citing information that had been gathered from local employers, who had been surveyed by the school and who had said in a response to a survey question asking what background knowledge they expected, or most wanted, their employees to have, "We don't care what they [the students] studied, we want a student who's respectful, who's responsible, who can work together with other people and want to learn, we can train them. We don't care. We don't need them to be honors students and all that. We can train them on the job. Give us kids who know how to be respectful, responsible, team players." It seems that the teacher's approach in class, including her use of computers, was a direct response to potential employers' expectations of her students rather than a concern with teaching science and producing students who knew how to conduct science like scientists do in the world outside school.

I have treated this example in depth not because it is special but rather because it is common and illustrative; it reflects not only what other teachers at the two schools are doing but what has been observed more commonly in education elsewhere (e.g., Becker 2000; Cuban 1986; Warschauer 1999). Technology by itself does not change the nature of schooling. At its best, it amplifies processes that are already under way. A school system that channels students into different social futures through a variety of mechanisms—including unequal funding, disparate teacher preparation, and a tracking system—will not be turned around by computers. It is more likely that the channeling effects of such a system will only be amplified.

Perhaps the most interesting part of this particular example is that the use of technology in the low SES neighborhood school was found not in drill-and-practice software but in collaborative writing and communication tasks. Indeed, the production of limited-content newsletters or Web sites was common in other technology-enhanced courses in the school and appears to be a rising trend nationally. I would suggest that this is in line with broader economic changes in U.S. society. In an era when basic computer literacy and teamwork is a requirement of almost all office jobs, more classrooms in low SES schools will likely focus on these skills. We thus might see a day in the future when across the board more low SES students are using the Internet than high SES students, but for the kinds of tasks that prepare people for basic office work rather than for scholarly pursuits.

Of course, an emphasis on vocational preparation in this school or other schools is not in itself wrong. Indeed, better preparing students for the work force is a widely accepted goal, and it may be especially important in communities with high levels of unemployment and poverty. And elsewhere in this book I highlight other educational efforts that are designed precisely to provide teenagers or adults with better job-related skills. However, this was not a vocational school but a comprehensive high school with the supposed mission of preparing students not only for the workplace but also for university studies. At this school, though, as in many low-income neighborhood schools in the United States, academic opportunities were constrained not only by low expectations but also by very difficult working conditions. Even the teachers at this school who wanted to offer more academically challenging projects had difficulty doing so because of large class sizes, lack of modern equipment, and insufficient time for preparation. Thus the effect of technology infusion, even in a school with talented, well-intentioned educators, was shaped and constrained by the broader social context.

However, while social context shapes what takes place in classrooms, it does not completely determine it. Excellent examples abound of teachers in low-income neighborhoods finding ways to use technology to support academic achievement. Two examples are discussed in the next sections.

Project Fresa: Fostering Critical Thinking with Technology Mar Vista Elementary School is located in the midst of strawberry plantations in Oxnard, California, a couple of hours' drive north of Los Angeles. About 80% of the students in the school are Latino (including Mexicans, Mexican Americans, and Latin Americans), and the majority of them have family members working as laborers in the strawberry fields. Even though most schools in California have ended formal bilingual education following a 1998 statewide initiative, Mar Vista is one of a small number of schools that have continued their bilingual programs thanks to a progressive administration and parental demand. Teachers at Mar Vista have also become leaders in effective use of ICT to promote academic skills and critical awareness among traditionally marginalized students. This is accomplished through theme-based project-oriented instruction that is sensitive to students' own social concerns while at the same time engaging students in complex and cognitively demanding learning tasks.

An example of this is Project Fresa,[6] a theme-based year-long project for primary school students. The project takes as its main focus the local strawberry (*fresa*, in Spanish) industry. The children begin by formulating their own research questions about the conditions of strawberry workers. They then use these research questions to generate interview and survey questions, enrolling their family members, relatives, and neighbors as respondents. (They often conduct the interviews in Spanish and then translate responses into English.) Afterwards, the students learn to record in spreadsheets and to produce graphs in various formats of the data they have gathered (analyzing, for example, which types of graphs best display which types of information). The graphs are incorporated into PowerPoint presentations together with photos and quotations from the people they have interviewed. With the guidance of the teachers, they then search on the Internet for further information about the conditions of strawberry workers and also invite guest speakers into their classroom from environmental and workers' rights groups. Based on the information obtained from the Internet and guest speakers, students write letters via e-mail to the strawberry growers, expressing any concerns they might have about strawberry workers' rights. In past years they have also sent e-mails to elected officials, such as the state governor, with real and informed inquiries about agricultural laborers' rights. After engaging in this kind of work, they begin an e-mail exchange with children in Puerto Rico who live in a coffee-growing area, to compare notes about the two industries and the condition of workers. At the end of the year, the students at Mar Vista hold a public presentation, to which their parents and other community members are invited, to display the multimedia products they have created.

Compared with using the computer for drills and exercises, this kind of project-based teaching has several strengths. Students learn to actively master technology rather than use it in a passive manner. They engage in their own research, data collection, analysis, and interpretation, and produce high-quality products such as letters to elected officials and data-based presentations. They also learn to speak out and take action on issues of importance to their community. Through gathering and evaluating information from a variety of sources, including workers, nongovernmental organizations, businesses, and politicians, students involved in Project Fresa gain a better understanding of how different players shape the strawberry industry and the conditions of its workers.

Technology Academy at Foshay Learning Center Foshay Learning Center[7] is an urban K-12 school in a socially and economically distressed neighborhood of central Los Angeles. Some 72% of the students in this school are Hispanics and the remaining 28% are African Americans. Almost all the students are from low-income families. The surrounding area is known for a high degree of unemployment, crime, and drug use. The school, under the leadership of the (recently retired) principal Howard Lapin, has succeeded in creating and maintaining well-organized programs that emphasize academic achievement. The school has won numerous national awards and was designated one of the best 100 high schools in the nation in the year 2000.

The high school portion of Foshay is divided into three academies: Finance, Health, and Technology. All students in the high school choose one of the three academies in which to locate themselves, based on their career interests and aspirations. While computers and the Internet are well integrated into all the programs of all three academies, students in the technology academy develop special expertise in this area. Within the technology academy, courses in the first year (grade 9) focus on topics such as programming and multimedia authoring. Students spend a good deal of time working on their own projects that focus on a variety of social themes. Some of these projects also involve developing authentic materials for the community, for example, developing promotional brochures for local nonprofit organizations. Others involve research projects on local social conditions.

The technology-oriented topics focus on genre, message, and purpose as much as they do on technique. For example, in learning to use PowerPoint, students discuss and practice specific presentation genres, such as a stand-alone PowerPoint presentation (where presentation is shown without a speaker and thus must be complete in itself) and a support presentation (in which the PowerPoint show serves to supplement what is said by a speaker). Through a number of individual and collaborative assignments, students develop a sense of how to use presentation software to communicate effectively. These lessons are then hammered home through interdisciplinary projects involving teachers from several content areas. For example, a social studies, English, and technology teacher might combine to organize a research and presentation project on a topic such as the conditions of immigrants in Los Angeles. The final PowerPoint presentation would be evaluated according to its content, language use, and technique through collaboration of the three instructors. By the end of their last term of high school, graduates produce a CD-ROM with a portfolio of all their multimedia work completed over the four years of their high schooling for use in their college applications or job searches. Internships at local technology firms during this final term also provide students with more direct opportunities to learn about the role of technology in society as well as to engage in meaningful commercial projects.

In summary, use of technology in U.S. schools appears to have a mixed impact on social inequality. In many circumstances, technologization of schools has worsened educational and social divides. However, outstanding examples exist for ways to integrate ICT to promote social inclusion. These involve not only a reorganization of the classroom but also a pedagogical approach based on critical collaborative inquiry and analysis.

Educational Technology in Developing Countries Developing countries must weigh two divides when they consider integrating computers into schools. On the one hand, failure to technologize their schools and their societies can lead to a heightened *international* divide, as they fall more and more behind technologically advanced countries of the developed world. On the other hand, too great an emphasis on technology, at the expense of more basic educational problems such as building and resourcing primary schools in rural areas, can lead to a heightened *national* divide between rich and poor or urban and rural.

The solution to this contradiction is to introduce ICT in measured ways into schools, through carefully designed pilot programs. That way, the country's educational leaders can best learn lessons about what works in particular national and local contexts, and better plan for larger-scale spending on technology as computer and Internet access prices continue to fall.

This approach, however, is often easier said than done, as illustrated through the following examples of the introduction of educational technology in two developing countries.

Egypt The government of Egypt has devoted substantial resources to the area of educational technology in recent years.[8] Through computerization of public schools, the government hopes to better prepare the Egyptian people for a technology-based global economy, and thus to help the country reach the educational, economic, and social levels of more developed countries.

The government has backed its commitment to educational technology with substantial resources. A national plan for the technological development of education was initiated in 1994 and soon thereafter a national Technology Development Center (TDC) was formed in the Ministry of Education. Since then the TDC has grown to over 600 full-time staff who have the responsibility for coordinating and implementing technology projects throughout Egypt's governmental school system.

The TDC has placed multimedia rooms in all secondary and middle schools, and many primary schools. These rooms comprise one to two high-end computers, a video projector, an array of software, and an Internet connection. In addition, all secondary schools and many middle schools have computer laboratories, with ten to fifteen computers running on MS-DOS or Windows platforms. At the same time, much of the Egyptian school curriculum has been transferred to CD-ROM format, and computer training programs have been established by the government for Egyptian teachers.

Unfortunately, the results of this substantial investment have been disappointing. The computers in the multimedia rooms—which effectively means only one or two computers per school—are spread too thin to make any real difference to learning. In any case, the rooms are often kept locked because local school authorities don't want to suffer the risk of having expensive equipment damaged through use by teachers. This phenomenon has been reported frequently in the Egyptian press. As one article ("PCs and Teachers" 2000, 2) exclaimed, "Primary school teacher Hasnaa el-Hefnawi is enraged by the decision to introduce the computer science curriculum. . . . The ministry has repeatedly tooted its own horn about how many computers it has supplied to schools. 'Doesn't the minister realize that these computers are kept in school warehouses like antiques or used merely for decoration?' she mused."

On the occasions when students do make use of these multimedia rooms, they generally watch the teacher lecturing, as is the normal practice in Egyptian education (Tawila et al. 2000), but this time with the aid of a CD-ROM and projector. The CDs themselves contain the same material as the students' textbooks, transferred to a new medium. With very large classes, poorly trained teachers, and a curriculum geared toward test preparation, there is little in the Egyptian educational system that would support more creative use of the multimedia rooms.[9]

Meanwhile, the computer laboratories are used almost exclusively for a course in basic computer literacy, which focuses on mastering DOS and Windows commands. Teachers of that class, as of other classes, are not allowed to depart from the prepared curriculum, nor are they prepared to, based on their knowledge, background, or training. The laboratories themselves, which could potentially offer a site for creative hands-on use by students in other subjects or after school, are not allowed to be used for anything other than the specified computer literacy courses.

Ministry of Education training courses for teachers similarly focus on basic computer literacy, such as how to turn on a computer, how to operate basic programs, and how to use a CD-ROM. No in-servicing is available for teachers concerning new pedagogical approaches involving technology.

Finally, Internet access in schools is routed by telephone via the Ministry of Education Offices to ensure better control. This necessitates a double-connection process that rarely functions. In any case, only the staff person in charge of the multimedia room in each school is given the Internet account information; neither teachers nor students are allowed to access the Internet on their own.

Meanwhile, the large sums spent on educational technology drain resources from Egypt's urgent need to improve its primary education. With a literacy rate of only 54.6%, and only 42.8% for women (UNDP 2001), Egypt's poor primary education is a major drag on the country's economy (Birdsall and Lesley 1999; Fergany 1998). Egypt already suffers from one of the more unequal educational systems in the world, with proportionally far too many resources going toward university and secondary education, which benefit only a minority of the population, as opposed to primary schools (Birdsall and Lesley 1999). Expenditures on technology, which are disproportionately devoted to secondary and tertiary institutions rather than to primary schools, are worsening this gap while thus far bringing no appreciable benefits.

Using technology to transform or even improve education is exceedingly difficult, and much wealthier countries such as the United States, have also had substantial difficulties. According to one international comparative study, almost every country goes through the same learning experience in implementing educational technology: first focusing on computer drills, then computer literacy, and only later learning the value of emphasizing real applications (Becker 1993). In other words, there are steep learning curves in the area of instructional technology for government officials and educators alike, and it is not surprising that results in Egypt have not matched expectations. Nevertheless, there are important lessons to be gained from the Egyptian experience that can be of value for any developing country that seeks to make use of technology to promote greater development and social inclusion.

First, computer resources that are spread too thin will have little impact. It is more effective to design narrower pilot programs that concentrate resources than to democratically sprinkle a small number of computers throughout the entire national system without any realistic plan to make effective use of them (Osin 1998).

Second, as emphasized throughout this book, it is counterproductive to place too much emphasis on physical resources without attention to the digital, human, or social resources that make effective use of technology possible. In this case, the Egyptian Ministry of Education did not develop original computer-based educational content or software for either teachers or students; did not engage in the kind of training programs that would have assisted teachers in making effective use of technology; and did not create communities or social structures that could have supported good use of technology. For example, simple technologies such as e-mail were not used to provide networked discussion and exchanges among teachers or administrators. The testing system that rewards students for memorization of rote material rather than creative or critical thinking was left in place. And steep vertical hierarchies within the Ministry of Education, which stifle opportunities for innovation or experimentation at the local level, were not challenged (and were in fact duplicated within the Technology Development Center itself). For all these reasons, it is not surprising that computers in Egyptian schools have been principally used to reinforce ineffective educational practices rather than help transform them.

There are many creative minds in Egypt working on issues related to education, technology, and social inclusion. For example, the Regional Information Technology and Software Engineering Center, a semipublic institution with national and international funding, has launched a large number of innovative 21st Century Computer Clubs in low-income neighborhoods throughout the country. Thousands of poor children have developed computer skills in these clubs, and some have gone on to participate successfully in international events such as the ThinkQuest competition for children's development of academic Web sites. The contrast between the success of this private initiative and the difficulties faced in public school settings demonstrates the importance of institutional context for constraining the access and use of technology.

China Some developing countries have had better success in launching and sustaining effective educational technology programs in public schools. A key to success appears to be well-designed pilot programs with a strong emphasis on curriculum development, teacher training, and pedagogical support (see Osin 1998). A national pilot program in Chile, called *Enlaces* (connections) received a positive review from the World Bank Education and Technology Team (Potashnik 1996). A similar program in Costa Rica seems off to an excellent start because of its strong emphasis on community participation and buy-in, teacher training, and use of technology to support broader curricular goals (Verdisco and Navarro 2000). Another interesting initiative is taking place in China, where the national Ministry of Education launched a national pilot project to investigate the possibilities of using new technologies in education.[10] The objectives of the project are to develop and try out new modes of classroom teaching with technology, to train teachers in integration of technology and education, and to generate a database of materials for computer-enhanced learning. The pedagogical underpinnings of the project are considered to be constructivism, meaningful learning, and student-centered learning.

A national core group led by Beijing Normal University, the national teachers college connected to the Ministry of Education, is working to develop curriculum and to oversee the project. A total of 600 experimental schools distributed throughout the country are participating in the program. Each of these schools has been equipped with a large, modern computer laboratory with Internet connections. Regional training centers also have been established in each of China's provinces to provide more direct supervision of the implementation in the individual schools. Each participating school sends a core group of two or three teachers to the center to participate in a ten-day initial training course that covers basic technology applications, theories of educational reform, and instructional design. The teachers then have follow-up training sessions and meetings at the regional centers and at their school sites.

Uses of technology consistent with the overall student-centered approach grounding the project are encouraged. These include teaching students to search for information, to actively master information technology tools, and to engage in autonomous learning. Beyond that, each school is given a great deal of autonomy in developing its own approaches to using the computer laboratory. In this way, the project organizers hope to encourage experimentation to see what materials, curricula, and pedagogical practices emerge that are effective in the Chinese context.

For example, NanTou primary school in ShenZhen city in southwest China has developed computer-based reading and writing materials to try to speed up literacy development. Learning to read and write Chinese characters is painstakingly slow and, when taught via traditional methods, monotonous because it involves large amounts of repetitive character and text copying. The school is experimenting at present with computer-based reading passages written in Mandarin Chinese, with glosses and dictionaries, as well as with involving young learners in computer-based writing of their own stories composing directly on the screen. Online supplementary activities include finding and reading fairy tales from Web sites and discussing them with other children through the writing of messages on online bulletin boards. Early results suggest that children are learning to write via computer much faster than they do by hand, and their creative writing activities are helping them learn to read faster (He and Wu 2001).

The project leadership team currently is researching the impact of the pilot project and is gathering data and information about best pedagogical practices that have arisen in response to placing computers in the schools. A CD is being developed by the project leadership with presentations introducing the overall educational approach, an instructional design plan, samples of courseware, supplemental instructional resources, teacher training video material (based on video clips of outstanding teachers), and reports on the evaluation process to date. The CD will be distributed to all the schools in China as a first step to try to promulgate the lessons learned from the pilot project.

The program is still in its early stages and is not without its serious challenges. As in Egypt, a test-driven curriculum provides a disincentive to develop student-centered modes of learning, especially in secondary school when students are preparing for exit exams. Though facing challenges, the overall design of the program—with a balanced emphasis on hardware, curricular resources, teacher training, and evaluation; with an initial implementation in a select number of schools; and with local experimentation and innovation actively encouraged—makes it likely that valuable lessons will be learned.

Distance Education

A final education focus related to technology and social inclusion is distance learning. In many people's eyes, Internet-based distance education shows the promise of obliterating obstacles of time and space, bringing educational resources to many people who previously lacked them.

Unfortunately, it does not always work out this way in practice, as seen by several studies of learning at a distance.

Network Science One of the most ambitious attempts to promote and document learning through Internet-based distance communication has been a set of projects known as network science. Launched in the United States in the 1980s, network science projects involved teams of children in classrooms throughout the United States and the world. The idea behind the program was that children would learn through collecting scientific data and sharing it on the Internet, providing a wealth of scientific information to promote constructivist learning. Typical network science projects involved measuring the acidity of local rainfall, tracking migrations of birds, or recording local weather conditions. In these projects, online information developed by the national or international project organizers provided instructions and supplemental materials. Chat rooms, bulletin boards, discussion forums, and e-mail lists provided opportunities for long-distance interaction.

Though these projects were presumed to support constructivist learning in the classroom, no one had really measured their impact until the late 1990s, when a research organization known as TERC carried out a five-year study of network science programs. TERC had been instrumental in launching and leading several network science programs, including some of the ones under investigation, so presumably the research scientists were hoping to find positive results. However, their final report (Feldman, Konold, and Coulter 2000) offered a devastating critique of the normal practices of network science. They found three main trends. First, students tended to upload data to the Internet without even bothering to download others' data. Second, when they did download data, they often had no idea how to analyze or interpret them in any meaningful way. And third, although the students reported that they enjoyed communicating with other students online, it was found that this interaction was usually about personal and social issues and had very little to do with science.

Some network science projects were successful, but only in cases where strong teacher mentoring, guidance, and instruction were taking place *inside* the classroom. The readings and instructions provided online were in themselves shown by the study to be ineffective in teaching children how to do science. Classrooms that depended principally on these online resources benefited little. But in classrooms where there was a very strong in-class component, with students learning how to collect, analyze, interpret, and discuss data before they ever went online, the Internet-based communication and resources added additional value. In other words, the central feature enabling effective use of Internet-based materials and distance communication was a strong local teacher working closely with students in face-to-face communication.

It is worth quoting from the summary of the five-year study:

> The experience of the network science curricula to date has led us to doubt that virtual communities for K to 12 students can replace classroom-based communities. Our reservations are based on how difficult it has proved to get substantive discussions going among participating classrooms. These reservations have been reinforced by our analysis of class discussions. . . . Given the timing, monitoring, nuanced voice, eye contact, and on-the-spot decision making required to engage students in reflective discussions, online discussions are a poor substitute by comparison. Most simply, the necessary subtleties of face-to-face interaction have no sufficient analogue online. It would be especially unfortunate if, in our ardent attempts to help classrooms get online discussions going, we inadvertently undermined efforts to improve the quality of class discussions. (97)

Finally, the research by Feldman and colleagues made it clear that distance communication faced the same limitations when used with teachers as when used with students:

> When faced with the costs associated with inservice teacher development, the possibility of using the Internet becomes an attractive alternative. However, the same critique offered earlier for why the Internet is ill suited for students learning the subtleties of substantive discourse applies as well to the challenge of teachers learning new pedagogies. The Internet may come to play an important role in sustaining contacts and building on experiences that take place in [face-to-face] summer institutes, but it is a poor substitute for such experiences. (98)

Advanced Placement Instruction Additional education programs, some of them designed explicitly to overcome digital and social divides, have yielded similarly disappointing results. For example, in the United States, most high schools in poor communities offer fewer Advanced Placement (AP) classes than do schools in rich communities. These classes are important because they provide high school students with college-level instruction and credits that they can use to offset time needed to be spent studying at college, and they also allow students to potentially raise their high school grade point averages (since many universities, in evaluating applicants' transcripts, award a maximum of 5 grade points for AP courses rather than the 4 points given for standard high school courses). Students who have taken and passed AP classes will thus have an advantage in applying for admission to elite universities compared with students who have not. At the University of California, Los Angeles, for example, the mean grade point average for entering students in 1999–2000 was 4.15 on a 4.0 scale, meaning that even applicants with perfect grade score averages would fall behind the mean without access to extra-value AP classes. Yet access to these courses is dramatically unequal; for example, Beverly Hills (California) High School, with 9% blacks and Hispanics in one of the wealthiest cities in the United States, offers thirty-two AP classes. In contrast, at similarly sized Inglewood High School, with 97% Black and Latino students in a low-income community merely twelve miles away from Beverly Hills, only three AP classes are offered (Wales 2001a).

In order to overcome the disadvantage to students of having access to fewer AP classes, a pilot program was established to offer AP instruction online in a low-income community in California (Wales 2001b). However, the pilot program was a failure, with 73% of the students who enrolled in the AP course dropping out before the course finished. Lack of personal, face-to-face contact was a principal reason given by students for dropping out. As one student explained, "The [online] teacher in this class is not like the regular classroom teacher who can be there with you every day when you need an answer or input." Another added, "Even though there was a [online] teacher there to help us, I felt that I might have stayed in the class if it were taught more by the teacher because I learn better from a [face-to-face] teacher rather than reading everything" (Wales 2001b).

A second iteration of the program was offered students in a continuation of the pilot program, but with much greater social support. Rather than taking the online AP course in isolation at home, students instead came to school, where they took the course in the computer laboratory with a teacher from the school present in the lab. Though the course was taught online by an expert AP instructor in another city, a local teacher was on hand in the computer laboratory to help students with computer problems and other matters. In addition, students received social support from their peers. Though this setting mitigated some of the advantages of anytime/anywhere learning, it was dramatically more effective for this group of low-income youth, with the dropout rate falling from the previous 73% to 14% (Wales 2001c). In this case, and perhaps in many more, a socially supportive environment easily trumped the advantages of 24/7 learning.

Teacher Training in Brazil Distance education programs overseas have shown similar patterns. For example, in Brazil, an Internet-based teacher training program was established to reach educators outside the major cities. The first time the program was run, 46% of the participants had dropped out by the end of the program and, for the remaining participants, much of the discussion online was dedicated to technical problems (Collins and Braga 2001). In later sessions, occasional face-to-face meetings were mixed in with the Internet-based program, and a 24-hour in-person online help service was added. As a result, the dropout rate decreased to 8% and the content of the interaction focused much more on pedagogical issues.

The Challenges of Distance Learning What lessons can be learned? Why do distance education efforts show such difficulties, and what are the implications for issues of social inclusion? The cases presented in this chapter so far suggest that online-based education is still beset by a range of delivery problems that impinge on learning opportunities.

Superiority of Face-to-Face Communication The first factor is the relative inferiority of online communication compared to face-to-face communication. Online communication has many advantages, as discussed in chapter 1, such as allowing fast-paced written interaction between people around the world. These advantages come into play best in particular circumstances, as when scientists discuss ideas on a discussion forum or a person with a disease seeks online information from others with similar problems.

However, in many other circumstances, face-to-face communication is superior to online communication. It is even more fast-paced and flexible than online communication, and it allows for the quick interpretation of gestures, facial expressions, and other audiovisual clues from dozens of people simultaneously as well as the quick and easy reference to drawings, charts, or physical artifacts. This rich human and physical environment allows students to better follow what a teacher is saying, and allows a teacher to quickly diagnose how students are following a presentation and thus make rapid adjustments to get a point across better. A warm smile or even a pat on the back from the teacher provides important affective support. The teacher can also rapidly break a class into pairs, small groups, or large groups, and easily have students move around the room to show each other their work and discuss ideas. While all these types of interaction can be simulated in various ways via computer, those computer-based interactions generally take much more time and are not nearly as rich in communicative content.

Value of Informal Networks Consider for a moment why a professional conference can be so valuable. Conference attendees may occasionally benefit from what they hear in formal papers and presentations, but they much more often benefit from informal interactions outside scheduled presentation sessions. The personal chat after a presentation, the morning coffee with a new or old colleague, and the chance encounter in the hallway or elevator all provide invaluable resources for the expansion of ideas and contacts.

Students receive similar or even greater value from their social environment. A tremendous amount is learned through informal interaction and social contact (Brown and Duguid 2000). First, casual interchanges can often alert students to answers to practical problems, such as how to operate a particular computer program. Second, informal encounters help introduce learners to new ideas that they may not have been aware of. Third, and perhaps most important, learners can better understand the outlook of their instructors by engaging in talk outside the formal classroom context. Think, for example, what a graduate student gets from close personal interaction with faculty members. By dropping in at professors' offices and chatting with them at will, the graduate student not only engages in conversation but also sees what papers are on the professor's desk, what books and journals are on the professor's shelves, and learns who else the professor might be talking to over the phone or in person. In this way, the graduate student comes to learn what it is like to be a professor and can better envision himself or herself becoming one, or at least carrying out similar academic work.

Two studies from the workplace—both discussed in Brown and Duguid's remarkable book *The Social Life of Information* (2000)—show the value of informal interaction for learning. One study examined how photocopy repair people carried out their work. The study revealed that the formal printed documentation they received was almost useless in helping them solve real problems on the job. An anthropologist who studied the repair workers throughout the day (Orr 1966, cited in Brown and Duguid 2000) discovered that it was over breakfast that they really engaged in learning—when they discussed over coffee the types of work-related problems they encountered and how they actually handled them. In a second situation (see Whalen and Vinkhuyzen 2000, cited in Brown and Duguid 2000), telephone support employees learned little in their formal training sessions. However, when they sat near other more experienced colleagues in their daily work, they observed firsthand how the veterans took calls, asked questions, and gave advice. If they didn't understand the answers given, they immediately walked over and had the person demonstrate the answer, using both the desk computer and the training manual. These types of highly valuable informal interaction, whether for workplace training or academic advancement, are not likely to be provided via online learning.

Economics of Online Instruction Finally, the economics of online instruction pose serious challenges to high-quality education. There are limits to how many students can fit in a classroom, but there is almost no limit to how many students can take an online course. Indeed, one reason that many university administrators are seeking to expand online education is for cost-saving purposes. By increasing the number of students per instructor and reusing online materials again and again, universities hope to make enormous savings. And universities are under a great deal of pressure to make these changes under competition from rapidly growing for-profit institutions that use online instruction and other types of technology to reduce their costs (Noble 1998a). Yet, it is precisely the more expensive types of online instruction—involving a high degree of professor-student interaction—that are proving the most effective (Feenberg 1999a).

All of these characteristics of online instruction have special significance for groups that are socially or economically marginalized. For example, in the United States, black, Latino, and low-income students already face severe challenges to succeed in the educational system. They have the weakest social networks outside of school to support advanced academic achievement because proportionately fewer of their relatives or neighbors have themselves received university education. They thus need the greatest support possible in schools and universities to succeed. This support should include rich face-to-face mentoring from teachers, counselors, and administrators, and plenty of informal interaction in dense social networks of peers and professors. Yet, because of economies of scale, it is low-income and minority students who are the most likely to be subjected to impersonalized education through more affordable but highly commercialized online instruction. A real danger in the United States is that one group of students, disproportionately wealthy, may attend small-class seminars in liberal arts colleges, while another group of students, disproportionately poor, may receive an undergraduate education through online diploma mills (Noble 1998a; 1998b).

Similarly, in Africa, Latin America, and Asia, good-quality local universities could face increased competition from online programs offered by American or European universities with a standardized international curriculum and big-name professors (whose lectures are offered via video tape), but without the kind of interaction, mentoring, guidance, and locally relevant curriculum necessary to support meaningful education. Some universities in developing countries, such as the University of South Africa, are making successful use of the Internet in education (Heydenrych 2001), but in these cases the Internet serves as a supplement to other media of instruction rather than as a replacement for them.

Distance education does offer important new possibilities for learners, such as the opportunity to access a wide array of instructional programs in one's own home. However, as I have argued, distance education also generates important challenges for educators. High-quality distance education programs demand close attention to the social context in which effective learning takes place. In many cases, that might involve a combination of face-to-face and Internet-based learning in order to maximize the advantages of both. Failure to consider the social context of distance education can actually result in worsening social stratification.

Conclusion

Human resources are one of the most important factors affecting social inclusion and exclusion. Literacy and education can be furthered through the use of technology but not merely through the provision of the hardware, software, and connections. A computer program or Web site can provide information but it cannot provide the kinds of social interaction that are at the heart of good education.

Effective technology-based educational programs, whether in community technology centers, schools, or universities, integrate active mastery of technology and engagement with challenging content. Student-centered projects are carried out, not as ends in themselves but as a process of apprenticeship toward relevant ends. Careful attention is paid to creating the social networks of interaction, networking, and support that allow learning to flourish.

In summary, information and communication technologies intersect with the struggle for better education, and not always in ways that benefit marginalized learners. The deployment of technology toward greater equality, inclusion, and access is in no way guaranteed but will depend in large part on the mobilization of learners, educators, and communities to demand that technology be used in ways that serve their interests.