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Whither the Digital Divide?

Mark Warschauer

The powerful role of information and communication technology (ICT) in social and economic development has led many to ponder the consequences of unequal access to it. In the mid-1990s, journalists, scholars, and political leaders started discussing the significance of what they termed a *digital divide* between the information haves and have-nots. In this chapter, I review the issue of a digital divide and efforts to address technological inequality.

Unequal Access

The idea of a digital divide first arose in the United States. Indeed, early studies of US Internet access revealed sharp disparities among users according to race, income, and educational level (National Telecommunications and Information Administration 1999). As computers and the Internet become more widely available at lower cost, however, and access rates among high user groups level off, access rates among minority groups, such as African-Americans, are catching up (Marriott 2006).

Internationally, gaps in Internet access remain more persistent. According to one recent analysis, the percentage of the population who use the Internet in each major world region ranges from 68.6% in North America to only 2.6% in Africa (Miniwatts Marketing Research 2006; see Table 7.1). Data suggest that eventually this gap will decrease, as in the United States, since access rates are growing fastest in the regions of the world with least access. Given the very low access rates in some countries and regions, however, vast gaps in ac-

Table 7.1 World Internet Usage

Region	Percent of Population Using the Internet	Usage Growth 2000–2005
Africa	2.6	423.9%
Asia	9.9	218.7%
Europe	36.1	177.5%
Middle East	9.6	454.2%
North America	68.6	110.3%
Latin America/Caribbean	14.4	342.5%
Oceania/Australia	52.6	134.6%
World Total	15.7	183.4%

Source: Miniwatts Marketing Research (2006)

cess rates might exist for decades, serving to keep large sections of the world's population isolated from the so-called information superhighway.

Statistical measures of Internet usage alone obscure several important questions. First, is lack of ICT access a cause or effect of poverty or other measures of social exclusion? Second, what does it really mean to have access to ICTs? And third, what is the best approach to dealing with unequal access?

Cause or Effect?

There is no doubt that unequal access to computers and the Internet is, to a large extent, an *effect* of poverty. It is not surprising that only 0.6% of the population of Malawi uses the Internet when the average annual income level in the country is barely the cost of a personal computer (Internet World Stats 2006). However, lack of access to ICTs is also believed to be a *causal* factor in impoverishment.

Consider the global relationship between gross domestic product, global exports, and Internet usage. According to data from the United Nations Development Programme, the fifth of the world's people living in the highest-income countries control 86% of global Gross Domestic Product (GDP) and 82% of global exports, whereas Internet users in those countries constitute 93.3% of the world total. In contrast, the 20% of the world's population living in the poorest nations control only 1% of global GDP and 1% of global exports, and

Internet users in those countries comprise 0.2% of global Internet users (Warschauer 2003a; see Table 7.2).

Analysis by Castells (1996) helps explain why GDP, global exports, and Internet usage are so tightly linked. As he points out, exports from the impoverished sub-Saharan countries in Africa tend to be predominately low-value primary commodities, the market value of which has fallen steadily over the last several decades. The exports of the wealthy countries are based on high-technology and high-knowledge goods and services whose corresponding market value has risen since the onset of the computer and Internet era. From 1960 to 1997, the share of world trade composed of high- and medium-technology goods rose from 33% to 54%, while the share of world trade composed of primary products fell from 45% to 24% (World Bank 1999). These data suggest that the richest countries of the world were able to make use of ICT to expand their control of world wealth, whereas the lack of ability to access and use ICT in economic production further weakened those nations that were already poor.

A similar dynamic is at play in ICT use and wealth among individuals in the United States. Prior to the computer era, there were large numbers of high-paying jobs in manufacturing, construction, or mining. However, from the early 1940s to 2000 the percentage of workers employed in manufacturing declined from 32% to 13% (Forbes 2004) and the percentage of the US workforce that is unionized fell at a similar rate (Joyce 2005). During the same period, there was a dramatic rise in the power, pay, and prestige of what Robert Reich (1991) has called *symbolic analysts*. These are professionals such as scientists, engineers, consultants, systems analysts, and designers who "solve, identify, and broker problems by manipulating symbols" (1991, 178). Symbolic analysts rely on ICT to network and communicate with other people, seek out and analyze information, and produce high-quality written and multimedia documents. In

Table 7.2 Shares of Global GDP, Exports, and Internet Users Among World's Population

	Poorest 20%	Middle 60%	Richest 20%
GDP	1%	23%	86%
Exports	1%	17%	82%
Internet Users	0.2%	6.5%	93.3%

other words, those who have the greatest access to and mastery of ICT have increased their socioeconomic position.

Elements of Access

What, then, does it mean to have access to ICT? If we consider access to mean the mere presence of a computer and an Internet connection, then virtually 100% of the people in the United States have access, if not at home or work, then through a public library. However, a number of analysts (Carvin 2000; Hargittai 2003; Warschauer 2003) have suggested that a broader view of access is required if we are to understand what enables people to deploy ICT in personally or socially meaningful ways. In my book on the digital divide (Warschauer 2003b), I analyzed these factors as falling into four general areas: *physical resources*, *digital resources*, *human resources*, and *social resources*.

Physical resources refers to the requisite device (desktop, laptop, handheld computer, Internet-connected personal digital assistant, or mobile phone) and Internet connection (via phone line or wired or wireless broadband link). A good deal of variation exists in terms of quality of computers and of Internet connections, so the physical resources themselves enable diverse types of ICT usage.

Digital resources refers to the content that is available online. According to research by Zook (2001), 65% of the world's Internet domains are located in the United States, Great Britain, or Germany, and the majority of the domains in these and other countries are concentrated in major urban areas. AU1 This is important in considering the digital divide on an international level, because the information needs of the rural population in Asia, Africa, or Latin America might not be well met by Internet sources from New York, London, or Berlin. Content diversity is also related to language diversity, with a disproportionate amount of Web content in English (Paolillo 2005). According to one recent estimate, there are hundreds of times as much content available in English per native speaker of that language as is available in Arabic, for example (Warschauer 2003a). The transition from the first-generation World Wide Web, which facilitated browsing but left writing and publishing difficult, to what has been called *Web 2.0*, which more easily allows writing, content creation, and publishing through blogs, wikis, and other means, can be helpful in reducing the vast divide in digital resources, if worldwide initiatives are able to mobilize local communities to produce their own Web content.

Human resources refers to the knowledge and skills required for meaningful use of computers and the Internet, which include both the traditional literacies of reading and writing, as well as a set of new digital literacies. The latter include *computer literacy* (the fluency, comfort, and skill in using a computer and its programs); *information literacy* (the ability to find, critique, evaluate, and deploy information from online and other sources); *multimedia literacy* (the ability to produce and publish quality work that draws on texts, images, sounds, and video); and *computer-mediated communication* literacy (the interpretation, writing, and thinking skills necessary to communicate effectively in, or help arrange and manage, various types of synchronous and asynchronous online interaction; for further details, see Warschauer 2003a).

Social resources refers to the social relations, social structures, and social capital that exist to support effective use of ICT in families, communities, and institutions. Two decades of research in schools, governments, businesses, and other institutions has revealed AU1 how successful incorporation of ICT inevitably depends on multifaceted and ongoing reform of social relations and incentives rather than merely on a one-time infusion of equipment (see overviews in Kling 2000; Warschauer 2003a).

The interaction between these sets of resources helps explain why problems of technology and inequality are so daunting, and why notions of a binary divide based purely on whether or not somebody has a computer are too simplistic. Rather, there are many degrees of access to ICT, depending on a complex combination of physical, digital, human, and social resources available.

Examples from Education

To illustrate the above points, I will draw examples from the deployment of technology in K-12 schools in the United States and Egypt. In the United States, educators and policy makers have long viewed public schools as a key venue for providing children with more equitable access to new technologies and the ability to use them. A number of federal and state programs have thus been set up to provide funding for hardware, software, and professional development related to educational technology. Due in part to these programs, as

Table 7.3 Ratio of Public School Students to Instructional Computers with Internet Access

Percent of Students Eligible for Free or Reduced-Price Lunch	1999	2000	2001	2002	2003	2005
Less than 35 percent	7.6	6.0	4.9	4.6	4.2	3.8
75 percent or more	16.8	9.1	6.8	5.5	5.1	4.0
Differential of high-poverty schools compared to low-poverty schools	+121.1%	+51.7%	+38.8%	+19.6%	+21.4%	+5.3%

well as to the falling cost of computer and telecommunications equipment, the overall ratio of students to Internet-connected instructional computers in public schools fell from a national average of 9.1 students per computer in 1999 to 3.8 in 2005. Throughout this six-year period, the student-computer ratio was larger in what are considered AU2 *high-poverty schools* (with 75% or more of their students enrolled in the federal government's free or reduced price lunch program) than in *low-poverty schools* (with 35% or fewer of their students eligible for the lunch program). However, the differential of student com- AU3 puter ratios between high-poverty schools and low-poverty schools fell from 121% in 1999 to about 5% in 2003. A declining gap in student-computer ratios also emerges when analyzing schools with high and low numbers of minority students.

Yet, as the equipment gap steadily shrinks between low- and high-socioeconomic status (SES) schools, there still exist substantial differences in how technology is used to support learning. A number of studies have found that teachers of high-SES students use new technology more frequently than do teachers of low-SES students (Schofield and Davidson 2004; Warschauer and Grimes 2005). In addition, high-SES students more frequently use technology in school for tasks that promote higher-order thinking, such as simulations and project-work, whereas low-SES students more frequently use technology for remedial drills (Becker 2000; Wenglinsky 1998).

I have conducted comparative case studies of educational technology implementation in high- and low-SES K-12 schools in California, Maine, and Hawaii (Warschauer, et al. 2004; Warschauer 2000;

Warschauer 2006) drawing on observations, interviews, examination of teacher and student artifacts, and comparison of survey and test score data. The studies helped illuminate the complex array of reasons why technology is used unequally by low- and high-SES students.

First, there is an important interaction between school and home access to technology. Teachers in low-SES schools are keenly aware that a number of their students lack home access to a computer and the Internet. They thus spend a good deal of time teaching their students how to use software. In contrast, teachers in high-SES schools correctly assume that virtually all their students have computers and the Internet at home, and most have support from their families in how to use them. This allows them to focus student use of computers in classroom on learning objectives, rather than software use. In addition, they are much more ready to assign research-based computer homework than are teachers are low-SES students, some of whom fear their students will not be able to complete it.

Second, the low-SES and high-SES schools in our studies had very different support structures for integration of technology. Low-SES schools in the United States have higher teacher and administrator turnover; a higher number of teachers without appropriate credentials; and less experienced teachers and staff than do high-SES schools; and fewer and less educated parent volunteers. Teachers in low-SES schools more frequently complained of lack of support structures to make scheduling arrangements, keep equipment functioning, or provide pedagogical support than did teachers in high-SES schools.

Third, there are important differences in the capabilities of students. Learners in high-SES schools, who have greater degrees of language and literacy skills, background content knowledge, and prior experience with technology, can much more easily make use of new technology to achieve sophisticated learning objectives. In contrast, low-SES schools contain a disproportionate number of English-language learners, students with limited literacy, and students who lack basic keyboarding or other technological skills. It thus becomes much more challenging to introduce technology to these students while also focusing on academic objectives.

And fourth, schools in high- and low-SES communities often have very different visions and goals, with former schools more sharply focused on preparing their students for university and the latter often explicitly or implicitly more directed to vocational training. Technology diffusion may help schools better achieve their goals, but is unlikely to change the underlying vision and goals of a school.

Egypt represents a very different context for introducing technology into schools. There, the government seeks to develop a more modern technological society and recognizes that ICT has a valuable role to play in that. The government and Ministry of Education thus created a large and ambitious Technology Development Center (TDC) with the mission of injecting more advanced technology in public schools. Initiatives of the TDC included placing multimedia rooms with two to three Internet-connected high-end computers in all high school and middle schools in Egypt, plus building a national network of 27 expensive videoconference centers.

I investigated the use of these facilities from 1998-2001 and found that their actual contribution to educational improvement was minimal (Warschauer 2003b). The stated goals of the TDC—to foster more interactive hands-on learning with technology—contradicted the social context of schooling in Egypt, which is known for poorly trained teachers, large class sizes, and a focus on rote knowledge. As a result, the multimedia rooms were seldom used and in many schools the computers remained locked up. The videoconference centers were used for high-profile international events that similarly had little impact on education. As a result, the considerable expenditures on technology brought few demonstrable results, and diverted funding from other educational needs, such as opening up more rural schools for the large numbers of girls in Egypt's countryside who lack educational opportunities. Research on the use of technology in education internationally, as well as in a wide range of social and economic contexts in the United States and around the world, suggests that similar dynamics are at work, with the usefulness of technology for addressing social problems highly dependent on other contextual factors (Warschauer 2003a). What strategies, then, are successful for using technology to promote greater social equality and inclusion?

Closing the Gap

First, analyses of targeted problems must begin with the examination of social structures, social problems, social organization, and social relations, rather than with an accounting of computer equipment and Internet lines. An accounting of equipment is part of the overall analysis, but a fairly small part; if interventions are designed to address social problems, they must be planned by focusing on the overall structures and relationships that give rise to those problems.

Once social problems or goals are identified, programs should be based on a systemic approach that recognizes the primacy of social structure and promotes the capacity of individuals or organizations for ongoing social change through innovation of those structures using technology. Corea discusses this strategy in depth, pointing out that information technology implementations often create only superficial change, with organizations returning to their ingrained ways once the new systems have been “absorbed into the previous web of calcified inefficiencies” (2000, 9). Rather than just foisting technologies haphazardly on people, a better solution is to foster the “long-term nurturing of behaviors intrinsically motivated to engage with such technologies” with the goal of achieving “an ‘innovating’ rather than a ‘borrowing’ strategy of growth as a means to reduce technological disparities” (Corea 2000, 9). This can bring about a “catching up process” through development of capacity “in the generation and improvement of technologies, rather than in the simple use of them” (Perez and Soete, quoted in Corea 2000, 9). All of this requires changes in the social environment to facilitate “the learning of new behaviors that propagate continuous improvements in conditions of living” (Corea 2000, 9). This process of innovation might take many forms. Rural teachers might learn how to create their own technology-based materials based on local conditions rather than only using commercial software developed for other contexts. A crafts cooperative might learn how to develop and manage its own Web site rather than just posting its announcements on somebody else’s. Nongovernmental organizations might learn to establish and run their own networks of telecenters rather than just attending cybercafes.

In promoting such efforts and programs, it is essential to understand and exploit possible catalytic effects of ICT. Many important changes in social relations may come from the human interaction that surrounds the technological process, rather than from the operation of computers or use of the Internet. For example, a new computer laboratory in a low-income neighborhood may also become a meeting hub for at-risk youth and college-student mentors. Or the involvement of community members in planning the laboratory may bring together new coalitions that can also work for other types of community improvement. The social importance of ICT in the information economy and society means that ICT initiatives often have powerful leveraging potential that can be used to support broader strategies for social inclusion.

The role of leadership, vision, and local "champions" (McConnell 2000) is crucial to the success of ICT projects for social inclusion. A common mistake made in ICT development projects is to make primary use of computer experts rather than of the best community leaders, educators, managers, and organizers. Those, however, who are capable of managing complex social projects to foster innovation and creative and social transformation will likely be able to learn to integrate technology in this task. On the other hand, those with technological skills, but who lack understanding of the complex human issues at hand or the leadership ability to address them, will usually prove less effective.

Finally, the process of organizing, designing, implementing, and evaluating ICT projects must itself be open to innovation and flexibility. Good big things come from good small things, and room for innovation, creativity, and local initiative is critical to give the space for good small things to emerge. Flexible pilot programs are thus an important part of the development process. Scalability is of course an important aspect, and the potential for scaling up has to be part of the formative and summative evaluation of pilot programs. But lockstep, centrally organized large-scale initiatives with no room for local experimentation and innovation do not meet the needs of a rapidly changing information society, economy, or educational system.

Conclusion

ICT is an amplifier of other social and economic factors and processes. It thus is rightly seen as having the potential to help individuals, groups, and even nations leapfrog over developmental stages. Yet, at the same time, infusions of ICT can also amplify existing inequalities, as the effective use of ICT requires other human and social resources and can magnify differences in their distribution.

The notion of a digital divide has focused the attention of the public and policy makers on the important intersection between technology and inequality. Research on technology and social change has indicated how complex this intersection is, and has suggested some possible directions to take in addressing the problem. By focusing on the diverse range of resources that enable meaningful use of technology, and seeking long-term solutions that strengthen marginalized groups' agency, we can best make sure that ICT is used to further a process of social reform, equity, and inclusion.

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WARCHAUER

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AU2
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AU3
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