Perspectives

# Digital Divide:

## Beyond the infrastructure

Technology is changing the way people work, learn, transact business and communicate. More people are going online daily for business transactions, personal communication, research and information gathering, shopping and interacting with government entities. Civic involvement in the political process and community participation are now taking place in cyberspace. In the workplace, technology has changed traditional industries and created new high-tech jobs. These changes are happening at lightning speed; digital connections are critical to economic, educational and social advancement.

According to the National Telecommunications and Information Administration, "Our country's most important resource is its people. In a society that increasingly relies on computers and the Internet to deliver information and enhance communication, we need to make sure that all Americans have access." We have become an electronic nation but the benefits of the new technology have not reached all Americans, creating a digital divide that could serve to further historical separation in our society. Technology holds the promise of uniting and empowering people and the country; it can create a digital future that strengthens parents, neighbors and communities.

Both personal ownership of computers and access to the Internet have increased steadily. During the past 10 years, government, business and nonprofit organizations have focused on equipping school classrooms with computers and getting schools wired for the Internet. Communities realize they need to develop modern telecommunications capabilities and cultivate a well-trained workforce to stay viable and remain competitive in attracting, retaining and developing businesses. While more Americans than ever have access to computers and the Internet, a gap between the haves and the have-nots persists.

This report examines some causes of the gap that go beyond the infrastructure. Calculating the percentage of wired homes or counting the number of students per computer does not give a complete picture. This report focuses on what private sector, nonprofit and government entities are doing and can do to help close the gap. Examples of programs in schools and communities across the U.S. that are working toward "digital inclusion" are highlighted.

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## Defining the digital divide

"Digital divide" is a dynamic catchphrase, with new definitions almost daily. Generally, it is understood as the difference between those who have access to computers and the Internet and those who do not. It also refers to the divide between those who have access and can effectively use new information and communication tools and those who cannot. The divide runs along social, geographical and generational lines. Factors contributing to the gap are income and education levels, race and ethnicity, age, household type, geographical location and disabilities.

The digital divide is a multi-faceted problem. Access to computers and the Internet alone will not narrow the economic, educational and social divide between those who will benefit from new technologies and those who will not. People need adequate training to effectively use the latest information and communication tools. Basic literacy, language differences and lack of technical skill all contribute to the inability of some to participate in the information age. People must be able to research and analyze information, evaluate sources and apply information on the job and in their everyday lives. Internet and software content must be socially and culturally diverse, and relevant to specific needs.

## Understanding the consequences

We are a dot.com society. People are expected to know how to purchase airline tickets, find government services, post a resume, bank and pay bills online. Businesses, including some insurance companies, now penalize their customers with additional handling charges if they do not use the Internet for transactions. Lifestyle, education and jobs are shifting from an industrial style to a global digital era. According to high tech advisors at the Gartner Group, a private company, "In just five years, the Internet will be so important for dealing with government and business that those who lack access or do not know how to use the Internet will find themselves functionally illiterate."

Connectedness is important across our society:

**Workforce**. Businesses, from the local auto repair shop to investment firms on Wall Street, rely on information and communication technology. As new jobs are created and old jobs are eliminated, or significantly transformed, workers need to be skilled in using technology. With these changes come new definitions for academic success, basic employment skills and the nature of work itself. For example, farmers are using geographic information system technology to evaluate soil conditions and fertilizer needs, manufacturing plants use computer-aided design, computer-aided manufacturing and robotics in their industrial processes and police officers use portable digital assistants while on patrol.

The earning prospects of people who lack technological skills are bleak. According to the U.S. Department of Labor, people who use computers on the job earn 43 percent more than other workers. As the workforce shortage intensifies, it is imperative that new workers are able to function in the information age. Currently, some 60 percent of jobs require technological skills, according to the U.S. Department of Commerce. In 1998, more than 350,000 information technology jobs were unfilled nationwide, according to the Milken Foundation Report *Transforming Learning Through Technology*, "opportunity lost because of a lack of qualified U.S. workers prepared for the digital age."

To ease the worker shortage, the federal government has raised the federal cap on H-1B temporary visas to increase the number of foreign technical workers in the United States, but there are other options. Training for both new and older workers is critically important to a healthy economy; neither business nor government can long support a digitally illiterate class of workers.

**Education**. Children in school today face new learning challenges that require a strong foundation of reading, writing, math, science and language skills. As the economy shifts to an information base, students must also have a high level of competence with computer and tele-communication technologies. This can only be realized if all students have equal access and teachers have the training and support they need to incorporate technology effectively into the classroom. The future workforce must have the ability to adapt quickly to new technologies and be committed to lifelong learning.

**Communities**. While digital technologies bring new opportunities for many, they can bring further isolation for those without access. Technology literacy will be the single biggest factor in the success of people and communities in the global information economy. New technology allows people separated by geographic distances to link and share their experiences, ideas and resources to solve community problems. To remain strong, communities need high-speed Internet connections and workers with technology skills. Workers, communities and the state as a whole could miss out on economic opportunities if online access is not widely available.

**Government**. The U.S. Office of Management and Budget projects that 75 percent of all transactions between individuals and government will soon take place electronically, including delivery of food stamps, filing tax returns, purchasing licenses and permits, and processing Social Security and Medicare benefits. In Minnesota, the Department of Administration has developed strategies to electronically deliver more state government services. Initiatives are underway to ensure the "Information Highway" reaches every community. Without access and skills to use technology, citizens will be further removed from the information and services they need.

**Citizen Involvement**. As the Internet joins the mix of mainstream communication technologies, it will be necessary to create opportunities for people to maintain a reasonable level of

participation in society. This can be achieved by development of diverse social, regional and cultural content. Communication strategies need to be developed to link groups with specific needs, such as the unemployed, seniors and the disabled with online resources, training and information.

Telecommunications can be a powerful tool for organizing neighborhoods to solve problems, and can foster participation in community, democratic and civic affairs. The Internet provides the opportunity for two-way communication, unlike the conventional one-way media methods. Citizens have an opportunity to come together and share ideas in common public space.

*"If this technology gap is not closed, the dream that the Information Age will bring economic advancement and social progress could give way to a future in which social divisions grow deeper and despair tightens its grip on those who are left behind. Realizing the dream will take a concerted effort at all levels, from Washington to the grassroots."* — The Benton Foundation

## Those affected by the digital divide

The multi-faceted digital divide has a ripple effect on the disadvantaged who are already struggling with economic, ethnic and language barriers. They encounter further inequity because they lack technology access and skill. According to the U.S. Department of Commerce, "Minorities, low-income persons, the less educated, and children of single-parent households, particularly when they reside in rural areas or central cities, are among the groups that lack access to information resources." There are telecommunication infrastructure disparities between urban and rural areas. In addition, there are inequities between inner city and suburban residents and buildings. Older inner city and rural school buildings are more difficult and costly to wire than newer suburban schools, which were wired for the 21st century when they were built.

Having technology readily available at home, in schools and in the community is taken for granted in many areas. Teachers often assign homework with the expectation that students have equal access to computers and the Internet outside the classroom. Employers have redefined entry-level skills to include the ability to use a wide variety of technology tools and applications efficiently.

Employers are struggling to find enough high-skilled workers. Large companies have the resources to buy skilled workers from the outside by paying top wages, or to build (provide current employees with training) from within to meet their needs. However, most information technology jobs exist in small to mid-sized businesses that do not have the resources or the time to develop their workers. They must depend on community-wide workforce development programs and educational initiatives to meet their needs. Approximately 80 percent of Minnesota's workers are employed by companies with less than 500 employees. According to the Department of Economic Security, the shortage of available highly skilled technology employees in Minnesota is projected to average 7,000 a year by 2005. Consequently, it is Minnesota's economy, and the state as a whole, that is affected.

*"The current and future health of America's 21st century economy depends directly on how broadly and deeply Americans reach a new level of literacy… strong academic skills, thinking, reasoning, teamwork skills and proficiency in using technology."* — The 21st Century Workforce Commission, *A Nation of Opportunity*

*"The technology gap harms not only poor individuals and their communities, but society as a whole."* — Benton Foundation

## Measuring the digital divide in America's homes

According to a report from the National Telecommunications and Information Administration, there was a dramatic growth in Internet access and computer ownership between 1998 and 2000. The national percentage of homes with computers rose from 42.1 percent in December 1998 to 51 percent in August 2000. The share of households with Internet access soared by 58 percent, rising from 26.2 percent in December 1998 to 41.5 percent in August 2000. Despite the growth, these figures are quite alarming;

**ADDRESSING INFRASTRUCTURE: VENTURA ADMINISTRATION *BIG PLAN* INITIATIVES**

In Minnesota, several Ventura-Schunk administration initiatives focus on developing the infrastructure for statewide high-speed communications and strong marketplace competition in telecommunications. The Department of Administration's *Minnesota Rural Internet Initiative* will create a strategic partnership with academia and the private sector to promote and develop an advanced telecommunications infrastructure where the state as "anchor customer" will be a primary purchaser of services.

In 1999 and 2000, the Department of Administration conducted statewide surveys of existing connectivity infrastructures. The objective was to determine which high-speed, bi-directional network connectivity and associated Internet access services are possible in rural areas of the state. The data has provided useful information on availability, technical capabilities and cost of broadband connectivity services for many telephone central offices throughout the state.

More information on *The Big Plan* telecommunications initiatives can be found on the Department of Administration's Web site at http://www.admin.state.mn.us/networked_for_the_future.html and in *Telecommunications in the 21st Century*, William Mitchell Law Review, Volume 27, Number 4, 2001, by David Fisher, Commissioner of the Department of Administration, with a forward by Governor Ventura.

*only one-half* of the U.S. population has access to computers, and even fewer have access to the Internet.

Although these figures suggest the divide is narrowing, there is a long way to go to close the gap. Factors contributing to this technology expansion include declining cost of computers and Internet access, as well as government, nonprofit and corporate efforts to fund and promote access. While the figures show progress, the divide continues to widen for certain demographic groups. Some experts argue that the division reflects the widening disparity of wealth in this country.

## Access to computers and the Internet

Like digital divide, "access" has multiple meanings. It can mean computers, at home, in schools or at community centers. It can also mean the ability to connect to the Internet, which is available in a variety of methods at various costs. With Internet connections, money buys speed.

A secondary divide has formed. It separates those with access to basic "dial up" service and those with access to a new generation of high-speed Internet options. Speaking of this secondary divide, Gartner Group Chief Executive Michael Fleisher said, "This will be the equivalent of having the moderate and upper classes in IMAX theaters while the underprivileged are still watching silent movies."

Basic telephone dial up modem service provides relatively inexpensive access, but at a slow speed, which limits use of many applications. Internet access with broadband, which includes digital subscriber lines, modems used on high-capacity coaxial TV cables and Integrated Services Digital Network, provides high-speeds at higher costs. Satellite and wireless technologies also provide Internet access. Some people are going online using their wireless mini laptops, portable digital assistants and other special high-tech gadgets.

## National data on home access

The U.S. Department of Commerce, the National Telecommunications and Information Administration published *Falling through the net: toward digital inclusion* in October 2000, the fourth report in a series of studies that focuses on the digital divide. Statistics in this section are from this report.

### *Race and ethnicity – gains, but the divide is still widening*

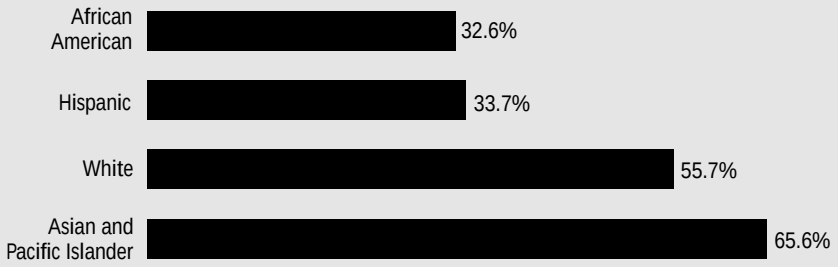
**Households with computers:** all ethnic groups experienced comparable increases in computer penetration since December 1998; however, large gaps remain. As of August 2000, the percentages of households with computers were:

- 65.6 percent for Asian Americans and Pacific Islanders, a 10.6 percent increase;
- 55.7 percent for Whites, a 9.1 percent increase;
- 33.7 percent for Hispanics, an 8.2 percent increase;
- 32.6 percent for African Americans, a 9.4 percent increase.

The August 2000 divide between African American households and the national average (51 percent) was 18 percentage points. A similar gap existed in 1998. A 17 percentage point difference between the share of Hispanic households with a computer and the national average existed in both 1998 and 2000.

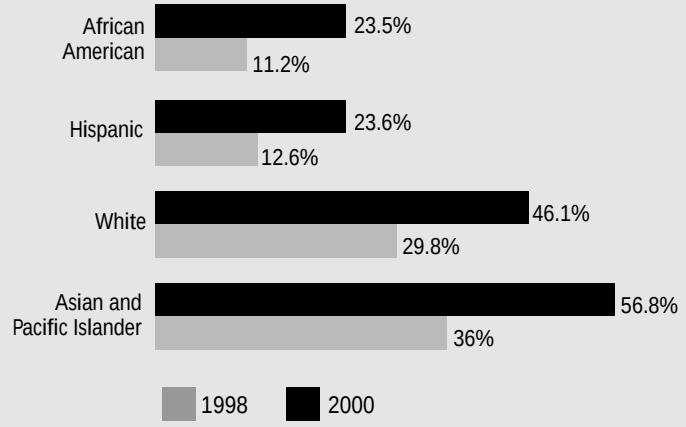
**Households with Internet access:** despite remarkable overall gains in home Internet access, ethnicity is still a barrier for many Americans. The divide between certain demographic groups remained large in 2000 and expanded slightly in some cases. According to the NTIA, African Americans and Hispanics still lag behind other groups. Asian Americans and Pacific Islanders have maintained the highest level of home Internet access at

**Percent of U.S. households with a computer August 2000**




Source: U.S. Department of Commerce

**Percent of U.S. households with Internet access 1998 and 2000**




Source: U.S. Department of Commerce

56.8 percent, compared to the national average of 41.5 percent.

In August 2000, African American households were more than twice as likely to have home Internet access as they were 20 months before, rising from 11.2 percent to 23.5 percent.

The divide between Internet access rates for African American households and the national average rate was 18 percentage points in August 2000 (a 23.5 percent penetration rate for African American households, compared to 41.5 percent for households nationally). The gap is 3 percentage points *wider* than the 15 percentage point gap reported in December 1998.

Hispanic households experienced a tremendous growth rate in home Internet access from December 1998 to August 2000, rising from 12.6 percent to 23.6 percent.

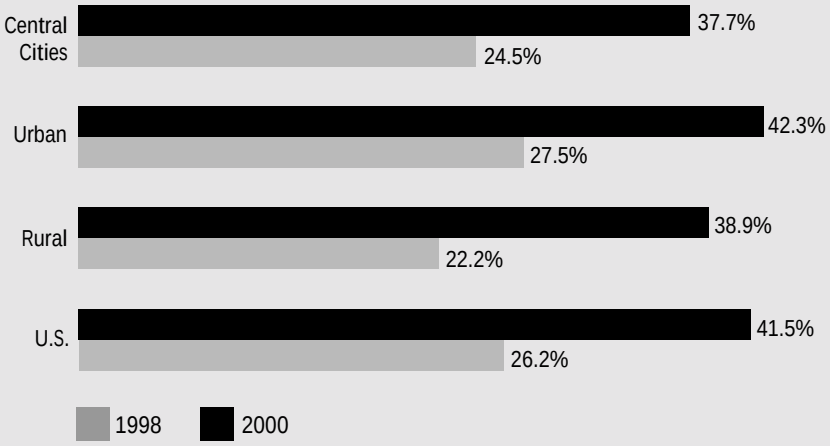
The Internet divide between Hispanic households and the national average rate was 18 percentage points in August 2000 (a 23.6 percent penetration rate for Hispanic households, compared to 41.5 percent for households nationally). The gap is 4 percentage points *wider* than the 14 percentage point gap reported in December 1998.

### *Rural America is catching up, but central cities are falling further behind*

Over the last two years, the Internet access penetration rate for rural households has increased dramatically. In August 2000, 38.9 percent of rural households had Internet access, a 75 percent increase from 22.2 percent in December 1998. The gap between households in rural areas and households nationwide with access to the Internet *narrowed* from 4.0 percentage points in 1998 to 2.6 percentage points in 2000.

Central cities, however, lag behind rural and other urban areas in terms of gains in access, and the gap appears to be *widening*.

**Percent of U.S. households with Internet access by location 1998 and 2000**




Source: U.S. Department of Commerce

■ In December 1998, 24.5 percent of central city households had Internet access, which was 1.7 percentage points lower than the national average.

■ By August 2000, 37.7 percent of central city households had Internet access compared to the national average of 41.5 percent. The gap *expanded* to 3.8 percentage points.

Internet access in urban areas continues to be highest; 42.3 percent of these households had Internet access, contrasted with 41.5 percent of households nationally in August 2000. The rate of growth between 1998-2000 was about the same as for center cities, about 57 percent. However, urban areas started at a high level, and continued to exceed the national average.

### *Divide between the wealthy and poor*

Income is one of the most important factors in home computer ownership and Internet access. Americans at every income level are connecting to the Internet at home at far higher rates, but particularly at the middle income levels.

■ Only 8 percent of families earning less than $10,000 annually have a computer, and within this group only 3 percent have Internet access.

■ Households with incomes under $15,000 increased their ownership of computers by 79 percent, from 7.1 percent in December 1998 to 12.7 percent in August 2000.

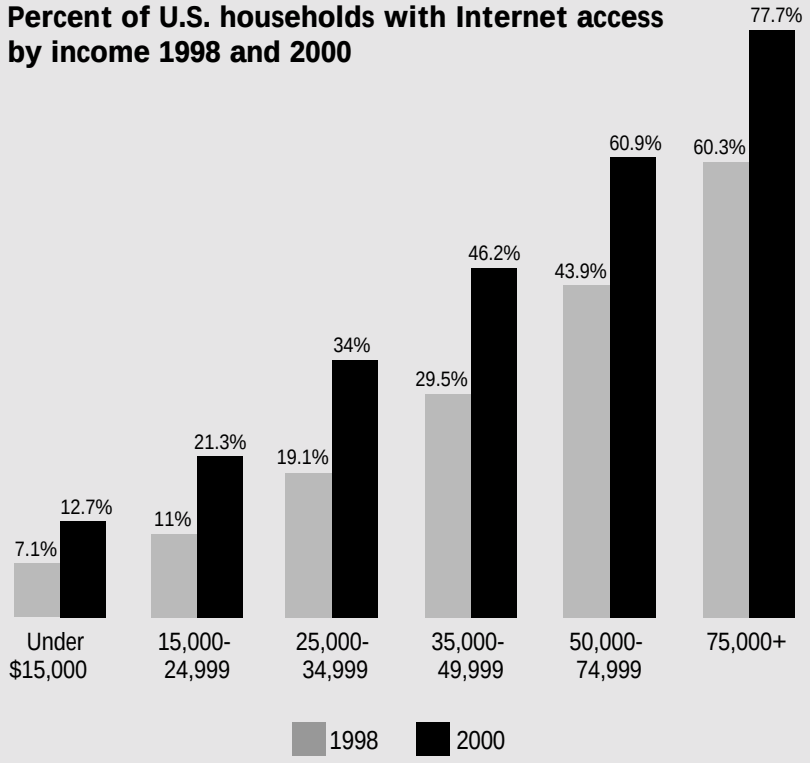
■ In the $15,000 to $24,999 income bracket, Internet access increased by 93 percent between 1998 (11.0) and 2000 (21.3).

■ Internet access among households earning $35,000 to $49,000 rose from 29.0 percent in December 1998 to 46.1 percent in August 2000.

■ Americans with incomes of $75,000 and higher are 20 times more likely to have access to the Internet than households at the lowest levels and nine times more likely to have a computer at home.

*"Because income and education are so highly correlated with whether households have Internet access, the question arises as to whether those factors might fully explain the observed gaps between the national average and the rates for Blacks and Hispanics. Those two groups as a whole have lower incomes and lower education levels than the national average."*
— National Telecommunications and Information Administration, *Falling through the net: toward digital inclusion*

**Percent of U.S. households with Internet access by income 1998 and 2000**




Source: U.S. Department of Commerce

### *Access to education equals access to technology*

Educational attainment remains an important influence on computer ownership and Internet access. Access is expanding across every education level, particularly for those with some college education. Households headed by someone with "some college experience" showed the greatest expansion in Internet penetration of all education levels, rising from 30.2 percent in December 1998 to 49.0 percent in August 2000. Better-educated people are also more likely to use a computer and the Internet through work and educational experiences.

In August 2000, the correlation between education and Internet access for households headed by someone with:

- Some post-college education – 69.9 percent
- A college degree alone – 64.0 percent
- Some college experience – 49.0 percent
- A high school diploma – 29.9 percent
- Education less than a high school diploma – 11.7 percent

### *Single parent households are at an information disadvantage*

Marital status and the presence of children are significant factors in home Internet access. The least likely to be connected are households with single or unmarried people, 28.1 percent. Male-headed households with children under age 18 are more likely to be connected (35.5 percent) than female-headed households (30.0 percent). Internet access is the highest for two-parent households, 60.6 percent, nearly twice that of single-parent households.

### *Generational divide showing signs of closing*

Individuals age 50 and older are less likely than younger Americans to use the Internet. However, this group experienced the highest rates of growth in Internet use of all age groups, 53 percent from December 1998 to August 2000, compared to a 36 percent growth rate for individual Internet use nationwide. The percentage of use by people age 50 and over varies greatly depending on whether the individual is in the workforce, 46.4 percent for active workers, 16.6 percent for non-workers.

### *Gender disparities disappearing*

The gap between male and female Internet users has disappeared. In December 1998, 34.2 percent of men and 31.4 percent of women were identified as Internet users. By August 2000, roughly 44 percent of men and women were Internet users.

### *People with disabilities are left behind*

People with a disability are only half as likely to have access to the Internet at home as those without a disability, 21.6 percent compared to 42.1 percent. Just under 25 percent of people without a disability have never used a personal computer; close to 60 percent of people with a disability have never used a personal computer. People with impaired vision and problems with manual dexterity use the computer less than those with hearing difficulties. Technology offers enormous potential for this group of individuals, but they have the lowest use rates.

### MINNESOTA DATA ON HOME ACCESS

Overall, Minnesota is slightly ahead of the national average in household access to computers and the Internet. According to the National Telecommunications and Information Administration, the percentage of Minnesota households with computers in August 2000 was 57 percent (51 percent nationally) and the percentage of households with Internet access was 43.0 percent (41.5 percent nationally).

## Home access is critical for success

Children without computers at home remain at a disadvantage. In 1999, 48 percent of teachers surveyed by the U.S. Department of Education reported assigning projects requiring use of a computer outside the classroom. Students without access at home are often not able to use school computers outside of regular school hours; school computer labs are closed, students have transportation issues, and they have other commitments after school. Many local libraries with computers and Internet access are overcrowded and have limited hours. In West Virginia, schools that receive state funding must provide access to technology during nonschool hours. This includes having computer labs open on weekends and during the summer, as well as checkout programs for laptops. Lack of home access for children of low-income families exacerbates inequities stemming from the higher student-to-computer ratios in high-poverty schools. Teachers have concerns when they see affluent students whiz down the information superhighway, while the poorest students are still using number 2 lead pencils and outdated encyclopedias.

### Best practices

#### *Union City School District in New Jersey*

In 1989, Union City schools faced a state takeover due to students' poor academic performance. The district adopted several reform efforts including a public-private educational technology partnership with Bell Atlantic. In addition to supplying schools with computers, the company was able to provide some district teachers and students computers to use at home. Student scores on achievement tests increased dramatically, a direct result of access to technology at home. The city also began Parent University in which students and their parents could take classes in math, English as a second language and computer skills. The program inspired many parents to go back to school to improve their employment skills.

#### *South Mountain High School in Arizona*

At this inner-city school in Phoenix, 1,000 new iMacs are being sent home with students who do not have access to a computer at home. To be eligible to receive a laptop, printer and software, students must maintain a "C" average, stay out of trouble and stay in school. All sophomores are eligible for the free equipment. Families attend four hours of training and must pay for Internet access if they want it.

About 75 percent of the district's students qualify for free or reduced-price lunch. School district curriculum director Jean Anderson said, "I was trying to think of different ways to level the playing field, between the higher-income and lower-income students." The district is spending $1.2 million for the giveaway in hopes of reducing the 10 percent dropout rate.

#### *Little Falls Community Schools in Minnesota*

The Little Falls Community Schools began a Laptop Initiative in 1997. Through this project they were able to decrease the student-to-computer ratio from 3:1 to 1:1. During the first year all 279 fifth-grade students received eMate300 laptops and in the following year all fifth- through eighth-grade students (approximately 1,100) had laptops. Teachers received monthly staff development training. Some of the benefits were immediate access to electronic formats, pride in work, use of higher order processing skills and no waiting to use the computers in the lab. The initiative was spotlighted at the U.S. Department of Education's 1999 national conference on educational technology, Evaluating the Effectiveness of Technology.

#### *Winona State University in Minnesota*

The Laptop Universal Access initiative began in 1997 with a primary goal of enhancing learning through the use of technology. Laptop computers, training opportunities and virtual classes are the cornerstones of the project. The university also has computer labs and computer access points across the campus. During each phase of the program, increasing numbers of faculty and students were given the opportunity to lease laptops. All first-year students in 2000 were required to have a laptop, either personally owned or leased through the school's subsidized program. Several departments, including

**CASE STUDY IN CALIFORNIA**

Cousins Alexis Lee and Zakie Render from Richmond, California worry about being left behind. While others in their classes are pulling down history facts from the Internet and composing essays in Microsoft Word, they are among a handful who still handwrite their reports. "The other students tease us and stuff, call us poor, because we don't have computers at home." (Zakie) "I'm worried I'm gonna flunk because I can't get the information the other kids can." (Alexis) "We have to use the dictionary or books at the library that have the wrong numbers for population and agriculture."

The computers at their school, Portola Middle School in El Cerrito, are reserved for computer classes and for teachers or have long lines of waiting students. Because Richmond has no middle school, the girls are bused to Portola and are unable to stay after school to use computers. Back in their neighborhood, Leonard McNeil, a community activist, has raised about $300,000 to build a multimedia center with a network of 20 computers in the subsidized housing project where the cousins live. Part of the funding has come from the U.S. Department of Education, which spent $10 million last year to provide computers in low-income neighborhoods. Community technology centers are providing new opportunities for many underserved people.

Source: *The San Francisco Chronicle* January 2000

*"If relevant and compelling information is not available online in forms that can be easily found and used by underserved Americans, this group – one that has historically had difficulty getting information and opportunities – will be further disadvantaged."* — Wendy Lazarus of The Children's Partnership

*"It is as important to create useful content on the Internet – material and applications that serve the needs and interests of millions of low-income and underserved Internet users – as it is to provide computers and Internet connections."* — The Children's Partnership

chemistry, marketing, music and the graduate nursing program, take advantage of virtual learning at remote sites.

## Access in communities

Computer literacy is more than being able to turn on the computer, e-mail friends, play games and type a paper using a word processing program. It can also be the ability to file one's income taxes electronically, do extensive research on family history, make vacation plans, track investments and design greeting cards. Community-based centers offer courses introducing technology and provide training to a broad range of individuals from senior citizens to preschoolers. Creative programs are springing up in low-income housing developments, religious centers, retirement communities and libraries. Generally, these programs are collaborative efforts between social service groups, government, nonprofits, academia and dedicated volunteers. They also serve as resources for other social needs within the community.

### Quality content is critical

Another dimension of the digital divide is access to quality, useful content. *Online Content for Low-Income and Underserved Americans*, a report by The Children's Partnership, a national nonprofit, nonpartisan organization, identified four significant content-related barriers:

**Lack of local information.** Lack of basic life information was identified as the number one barrier by a focus group moderated by The Children's Partnership. People wanted information about jobs, including those requiring entry-level skills, childcare resources, housing, local schools, transportation, as well as community recreation and events. "While this barrier potentially affects a great many Americans, it disproportionately affects Internet users living on limited incomes, especially the nearly 21 million Americans over age 18 with an annual income of less than $14,150 for a family of three (federal definition of poverty)," according to The Children's Partnership report. When this type of information is available on the Internet, it is generally written for an audience that reads at an advanced literacy level.

**Literacy barriers.** Roughly 20 percent of the adult population, approximately 44 million people according to the National Center for Education Statistics, do not have the reading and writing skills necessary for functioning in everyday life. The Internet provides an opportunity to raise literacy levels and develop these skills. However, appropriate online literacy content is difficult to find and generally available only on expensive commercial sites. Of the 1,000 sites The Children's Partnership reviewed for limited-literacy content, only 10 percent were considered adequate.

**Language barriers.** It is estimated that 87 percent of Internet content is written in English. Yet, according to the Census Bureau, 32 million Americans use a primary language other than English. There are only a limited number of sites that provide easy access to translation. Few government, educational and library sites have information in multiple languages or with options for the disabled.

**Lack of cultural diversity.** There are a growing, but limited, number of Web sites for people to share information about their heritage and cultural practices, including art, music, food, sports or other race or ethnic-specific topics. Health information on the Internet rarely includes diseases and illnesses specific to various races or cultures.

### Best practices

#### *Community technology center in California*

The Eastmond Computing Center in Oakland is a community technology center focusing on employment, job training and placement for youth. The center is also a resource for local schools, libraries and nonprofits in this underserved community. The center's goal is to empower community residents to take charge of their future by providing technology information and assistance. They offer free computer and Internet access, technology classes and school-to-work transition services. People are encouraged to assume responsibility for their own learning, to work together and mentor others.

The center hosts over 250 Web sites, which are designed by the newly trained youth for community-based nonprofit organizations. The center has become a hotbed of entrepreneurship, self-help, face-to-face networking and a gathering place for citizens. However, despite its success, center staff feel they are only scratching the surface of community needs. The majority of the center's 400 weekly clientele need the most basic introduction to computers and the Internet. Additional specialized training is needed for people to be employable in the digital age.

The center partners include local libraries, nonprofits, business and government entities. They strive to be a national example of how important community technology centers are in preparing people for a digitally literate future. More information and resources can be found on its Web site: http://www.eastmont.net/

### *Community/education partnership in Minnesota*

University Center Rochester is a collaborative community education network with the University of Minnesota, Winona State University and Rochester Community and Technical College. The community education hub provides local access for higher education students in Minnesota and worldwide, a link between business and community sites and a connection between K-12 schools and higher education. The goal is to provide education and training necessary to support the region's workforce development and knowledge-based economy now and in the future. A pilot test site of the Minnesota Virtual University, it extends access to online educational courses and programs. TechNet, a one-stop support center, provides technical support, individualized instructions and computer "camps" to assist faculty in using specialized equipment. Through interactive television, students are able to attend classes while away from campus.

### *Community partnership in Washington*

In Snobomish County, 4-H clubs partnered with a local senior center to establish a "Computers for the Ages" program. Teens in the 4-H program and other community volunteers maintain the computer lab. Seniors use the lab weekdays and 4-H members use it during the evening and on weekends. In the past year, more than 500 seniors have received training on how to buy a computer, various software programs, e-mail and the Web. Specialized classes in genealogy, travel planning and searching for medical information are available for the seniors.

Microsoft Corporation provided grant money, equipment, Web site design and software upgrades. Program fees are used to maintain computers and printers. The local phone company, GTE, provided a special computer that uses voice recognition software and wireless keyboard/mouse for people with disabilities. The program won the 1999 Youth Collaboration Award of the Human Service Council of Snobomish County.

### *Red Rock Community Network in Minnesota*

The Red Rock Community Network is a project of the Red Rock Central School District in southwestern Minnesota. It was started by high school students who built an electronic community of over 500 users including university and K-12 educational partners, city and county governments and community businesses. RRCNet began as a grassroots effort to provide Internet access, computer training and technology planning for a rural area. Its vision is to revitalize aging communities and assist in the transition to the new economy by providing access to the Internet, an area computer lab and leadership in technology planning. The volunteer technical staff are Microsoft, Novell, and Unix certified. RRCNet takes a grassroots approach to serving a community's information technology needs. The cross-sector, cooperative approach also works to ensure the sustainability of this community asset. See www.rrcnet.org

**COMMUNITY RESOURCES**

*NetPlan,* a free publication from a collaborative of Minnesota state agencies, is a tool communities can use to plan their telecommunication needs. Copies are available online at www.mnplan.state.mn.us or by calling 651-296-3985.

Community Technology Centers' Network (CTCNet), Alliance for Community Technology focuses on underserved communities and offers access, training and technology expertise. www.communitytechnology.org.

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## Measuring the digital divide in schools

The percentage of public schools connected to the Internet increased from 35 percent in 1994 to 95 percent in 1999, according to the National Center for Education Statistics. The center also found that nearly all public school teachers (99 percent) reported having computers available somewhere in their schools in 1999; 84 percent had at least one computer available in their classrooms.

Data on computers and Internet access in schools can be confusing and misleading. The student-to-computer ratio is the most frequently used indicator of progress to measure the closing of the digital divide; that is, the lower the ratio, the more access students have. The ratio of students per instructional computer with Internet access decreased from 12:1 in 1998 to 9:1 in 1999. According to the President's Committee of Advisors on Science and Technology, a ratio of 4 to 5 students per computer represents a reasonable level for the effective use of computers within schools.

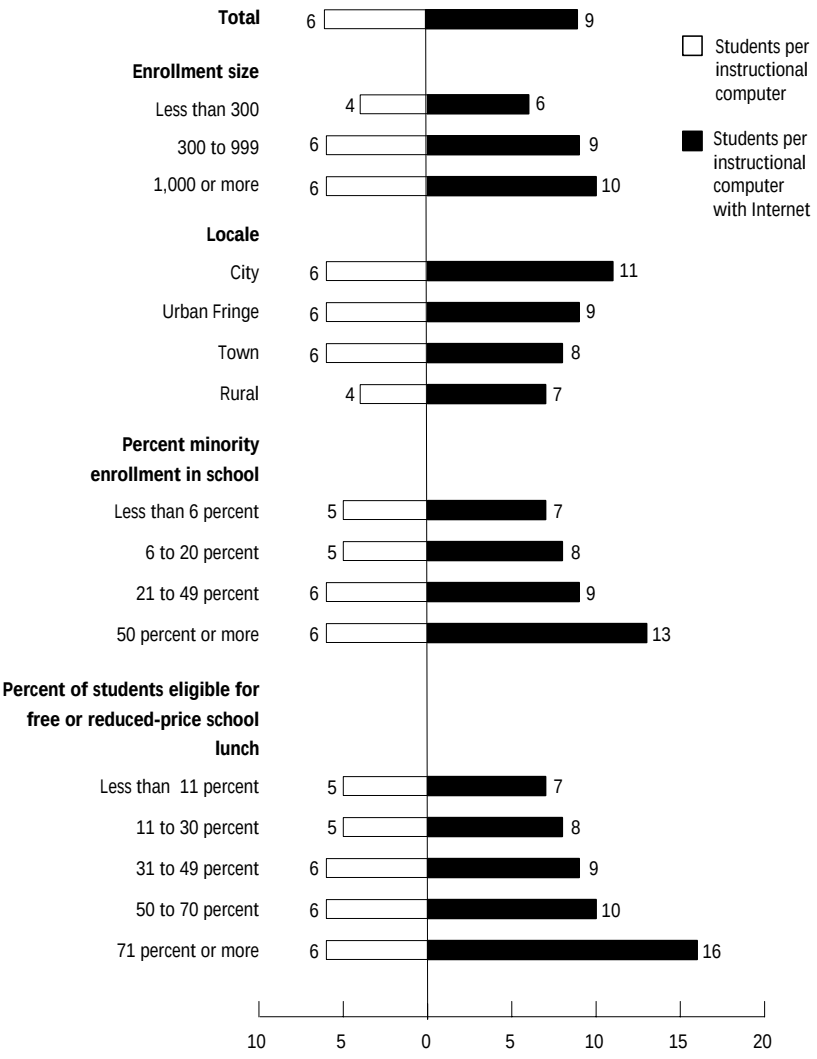
However, the student-to-computer ratio is a measure that varies greatly depending on what is counted:

- Are old and outdated computers stored in the closet counted?
- Do students have access to the computers or are they for administrative use?
- How many computers are broken and useless?
- Are the computers connected to the Internet?
- Where is the Internet access – administrative offices? classroom? computer lab?

Some researchers use figures for multimedia computers only, others use figures for computers with Internet access, while still others count instructional computers. In addition, this measure does not reflect the amount of time a student actually uses the computer, nor does it measure what the student is using it for. Some schools are wired for Internet access, but the access point is in the school office, not in the classroom. There also is a discrepancy in the percentage of classrooms wired for Internet access, and those wired but without computers connected for student use.

To more fully understand the situation in schools, distribution by school characteristics must be examined. Many factors that influence access to technology in general also influence access in schools.

**Ratio of students per instructional computer and students per instructional computer connected with Internet access, Fall 1999**




Source: U.S. Department of Education

## Economic status

■ Schools with the highest percentage of economically disadvantaged students have the highest student-to-computer ratio.

■ As the number of low-income students increases, the ratio of students-to-computer increases.

## Minority enrollment

■ Schools with a large percentage of minority students are less likely to have Internet access in the classrooms than schools with lower numbers of minority students.

■ High-minority schools have higher ratios of students-to-computer.

■ Teachers in schools with more than 50 percent minority enrollments are more likely to have outdated, incompatible or unreliable computers than teachers in schools with less than 6 percent minority enrollment.

## Geographic location

■ Inner-city schools have more students per Internet-connected computer than rural, urban fringe and town schools.

■ Rural schools have the lowest student-to-computer ratio.

## Enrollment size

■ Smaller schools have a lower student-to-computer ratio than medium and large schools.

■ The lower the student enrollment, the more likely the school has Internet access in the classroom.

■ Teachers in large schools are more likely than teachers in small schools to have only one computer in their classroom.

## Computers and Internet access in Minnesota schools

Comparative statewide data on access to technology across Minnesota school districts is not available. Without a complete inventory of all public schools and districts, it is impossible to fully evaluate disparities. A statewide technology inventory system could be developed, such as Maryland's annual statewide inventory of technology resources in public schools. It measures access to equipment and networks,

**ST. PAUL APPROVES FUNDING**

In November 2000, St. Paul residents passed a funding referendum that will provide approximately $415 per student in additional funds for the next five years. School-based site councils will make recommendations on how the money will be used to improve student achievement. It is expected that several schools will use part of the money for technology. Currently, the student to Internet-ready computer ratio is 19:1 in St. Paul. About 85 percent of classrooms are wired for the Internet; however, only 35 percent of classrooms have computers that are connected to the Internet for student use, according to the Vote Yes St. Paul Schools campaign.

availability of technical support, level of teacher knowledge and skills, and the use of technology. Individual school districts in Minnesota are not mandated to establish technology plans, but are encouraged to do so in order to qualify for the federal E-Rate Program as well as other federal and state grant opportunities.

In 1999, Minnesota remained above the national average in *Education Week's* annual public school survey, *Access to Technology*, with:

- 4.9 students per instructional computer (5.7 national average)
- 8.6 students per instructional multimedia computer (9.8 national average)
- 9.6 students per Internet-connected computer (13.6 national average)

The survey also reported on connectivity of Minnesota schools in 1999:

- 83 percent reported at least 50 percent of teachers had school-based e-mail addresses
- 96 percent had Internet access
- 84 percent had Internet access from one or more classrooms

## Best practices

### *Access in South Dakota schools*

Connecting the Schools is South Dakota's award winning statewide project to provide access to technology throughout the state. The project is fully funded by the state, which allows schools to focus their local funds on other technology areas. Governor Bill Janklow's innovative project cost an estimated $15 million, a fraction of the $100 million private sector estimate. Using inmate labor, the project established a leading-edge infrastructure for existing and future technologies and provided the opportunity for incarcerated men and women to develop valuable skills and work habits.

**GAUGING COMPUTER USE IN SCHOOLS**

To accurately track how many students there are per computer or the percent of schools that are wired for the Internet, school districts, state and local government officials and parents should ask the following questions:

Are the computers for student use or for administrative use?

Are the computers up-to-date and working?

Does the school have a technical support person?

Are students using computers for more than drill and practice?

Have the teachers received training on how to incorporate technology in their curriculum?

Do students have access to Internet connected computers? When and for how long?

Is content available in multiple languages and at various reading levels?

What level of competency are children achieving?

Launched in 1996, the comprehensive program built the infrastructure, provided standardized equipment to all schools, established wide area network facilities, offered hardware and software training, and managed the network. Phase one provided each school with wiring, equipment and training. Phase two built the Digital Dakota Network, the high-speed telecommunications network that connected educational (K-12 public schools, public and private universities) and governmental (libraries, city and county governments and the three branches of state government) entities. Links to parochial and Native American schools are being developed. Phase three focused on distance learning.

South Dakota received a perfect score of 100 in both the K-12 and higher education categories of the 2000 Digital State Study, a 50-state survey conducted by the Progress and Freedom Foundation and the Center for Digital Government. Minnesota scored 13.3 points and ranked 46th in the K-12 category and scored 38.9 points and ranked 47th in the higher education section.

## Teachers and technology training

In the classroom, technology can expose students to exciting new learning opportunities, but educators need the skills to fully use these tools. Many teachers are not confident in use of the equipment or do not have the experience and training to effectively integrate it into their curriculum. According to the National Center for Education Statistics report, *Teachers' Tools for the 21st Century*, only about one-half of public school teachers with computers available in their schools used them for classroom instruction. Only one-third of teachers reported feeling very well or well prepared to use computers and the Internet for instruction. The access inequities between low-poverty schools and high-poverty schools are mirrored in the amount of training and support teachers have available to them.

Training must provide more than basic skills; it needs to provide educators continuing support and specific instruction to effectively integrate technology into their curriculum. Teachers need to feel

*"Because low-income families are less likely to have new technologies in the home, and low-income schools are usually ill-equipped with communications systems these children face a doubly acute risk of information isolation."* — The Children's Partnership

confident enough to use technology in front of a classroom of children and to teach in new ways. Often, students in the classroom are more experienced and technologically savvy than the teacher. These students can be partners in the classroom; they can keep equipment running and upgraded, and share their knowledge. A change in perceptions may be needed.

The old style of teaching, with an environment of teacher-centered instruction, isolated work, passive learning and information delivery, worked well in the mass-production economy. Today, teachers need to adapt their teaching styles to coincide with the information age by mentoring student-centered learning using multimedia tools, collaborative work and information exchange. Future employers will place a premium on workers who are flexible, innovative, self-directed and able to solve problems collaboratively.

Unless current and future teachers receive training to effectively use technology and teach with new tools, students will not gain the knowledge and experience they need to succeed. Staff development and skill training should be ongoing and accompanied by technical support and encouragement from the district and the state. Training current and new teachers to effectively use technology for teaching and learning is needed. If teachers are to embrace the power of technology, they need the time to explore ways to incorporate technology as a teaching tool.

## Best practices

### *Teacher training programs*

■ The Mississippi Department of Education sponsors The Technology in the Classroom program. Exemplary technology-using teachers receive more than 140 hours of training on topics that include integration of technology into the curriculum, the use of technology tools and the application of leadership skills. Following the training, one teacher is assigned to every school to mentor fellow educators.

■ Technology for Educational Achievement in Wisconsin is providing public school districts with almost $200 million over the next two years for loans, grants and subsidies for education technology. Funds can be used for wiring, equipment, teacher training and other purposes related to education technology.

■ The Alabama Supercomputing Program to Inspire Computational Research in Education is a free training program for K-12 teachers. The program aims to train teachers to use Internet-based investigative techniques so they can stimulate student's interest in science, math and core subjects. In addition to workshops and teacher training institutes, there are nine regional training centers located in schools across the state that assist teachers throughout the year. The project is funded with 90 percent federal funds and 10 percent nongovernmental sources.

### *Public and business partnership in California*

Pacific Bell began the Education First Initiative in 1994 before the term "digital divide" was in widespread use. The initiative helps outfit schools with telecommunications infrastructure to access the Internet and participate in video conferencing and helps educators develop skills to effectively use interactive data and video applications. Initially, Pacific Bell spent $100 million for ISDN lines, hardware and software in 9,000 California schools and libraries in the company's service area.

Providing access to technology was only the first step. In 1995, the initiative funded three fellowships at San Diego State University to create online lessons and resources for educators. The Knowledge Network Explorer Web site (http://www.kn.pacbell.com/index.html) contains links to thousands of lesson plans, Web-based learning resources, and tools to be used in schools, libraries, community technology centers and homes. The site includes material for different levels of learners and bilingual content.

A team of former teachers and librarians make up Pacific Bell's Education Advocates. They provide free customized training and workshops throughout California to introduce new technologies and help integrate existing technologies. Their goal is to build education communities throughout the state. According to Delaine Eastin, California's state superintendent of public instruction, "This endeavor is a prime example of private sector support for education by creating a positive learning environment, using today's technology, that will enhance all of our efforts to improve education."

## Finding and evaluating appropriate content

While there is no shortage of software and educational Web sites, teachers face the daunting task of selecting the appropriate content for a variety of learning levels and languages. Content must engage students and meet the requirements of the curriculum and school standards. Once curriculum is selected, teachers must decide how to use it, which teaching style is appropriate and how to schedule students' time, especially if there are a limited number of available computers. This entire process takes time, a limited commodity for teachers, and appropriate training.

> "*It's not like a textbook…you have to sit down and load it onto your computer and figure out how to use it before you can even begin to evaluate the content.*" — Bridget R. Foster, director, California Instructional Technology Clearinghouse

The state education departments in California and Ohio publish software reviews and lesson plans to guide curriculum directors and teachers as they decide how to align digital content with curricula. According to *Education Week*, only 12 percent of respondents to their survey said their state or district provides lists of software titles that match curriculum standards. In addition, only 23 states have a group purchasing program for instructional software for schools.

*Education Week* surveyed teachers regarding use of and attitudes about

digital content. The survey revealed several reasons why four of 10 teachers say their students do not use classroom computers at all during a typical week:

- Most digital content is designed to be a supplemental resource
- Lack of time to prepare or try out software
- Cost of software – one out of five teachers pays for it personally
- Lack of training

## Best Practices

### *State content sites*

- Florida: Online users can explore the state's natural habitats on "Web World Wonders," through the use of live video cameras on the Internet. Lesson plans and student activities that correlate to the state education standards are available to teachers. The project is part of the United States Distance Learning Consortium Star Schools Grant, funded by the U.S. Department of Education. USDLC is composed of five state departments of education: Florida, Illinois, New Mexico, North Carolina and Texas. Other partners include higher education institutions, a local education agency, two state schools for the deaf and a non-profit distance learning programming network, StarNet. http://webworldwonders.firn.edu/

- Virginia: "The Valley of the Shadow" is a CD-ROM and Web site that takes two communities, one northern and one southern, through the experience of the American Civil War using GIS data. The project is a hypermedia archive of thousands of sources from Augusta County, Virginia, and Franklin County, Pennsylvania. Those sources include newspapers, letters, diaries, photographs, maps, church records, population census, agricultural census and military records. It is a research project at the University of Virginia intended for secondary schools, community colleges, libraries and universities. http://jefferson.village.virginia.edu/vshadow2/choosepart.html

- Iowa: "Earth Trails: The Mississippi River," is an interactive online field trip on the river, featuring streamlined video and other classroom materials. Iowa worked with its public television stations and used federal Star Schools grant funds and nonprofit funds to create this site. Middle-school students can use the Web site to learn about the route and history of the Mississippi River and the culture of the people who live along it. www3.iptv.org/interactive/fieldtrip/

- California: Multimedia project "Ancient World" features artwork, video clips and maps. The educational software, which is meant to be accessible to a wide range of students, including those with limited English proficiency, includes model lessons for classroom teachers.

- Minnesota: Sharing Environmental Education Knowledge is sponsored by the state Office of Environmental Assistance. SEEK contains a wide variety of resources for environmental education, lesson plans and links to a variety of government, business and educational sites. The site also contains information about Minnesota High Standards, a component of state high school graduation standards, and training opportunities. www.seek.state.mn.us/

### *Federal content sites*

- The Gateway to Educational Materials is a project of the U.S. Department of Education and the ERIC Clearinghouse on Information & Technology. It provides educators with quick and easy access to the substantial, uncataloged collections of educational materials found on various federal, state, university, nonprofit and commercial Internet sites. http://www.thegateway.org/welcome.html

- In response to President Clinton's request, more than 30 federal agencies formed the Federal Resources for Educational Excellence Web site. FREE is a vast collection of federally supported education resources for teaching and learning. http://www.ed.gov/free/

- The National Aeronautics and Space Administration has a Web site of resources for K-12 and higher education students, teachers and community programs. Programs contain a wide variety of educational formats: electronic multimedia textbooks, lesson plans, interactive workshops, videoconferencing, GIS technology and resources for teachers. Options to select the appropriate reading level and English, Spanish or American Sign Language are available. See http://www.nasa.gov/

## Using technology to improve learning

Computers are used in many ways in the classroom, from routine practice sessions to more advanced work such as creating databases for researching and analyzing information, desktop publishing and geographic information systems. According to the National Center for Education Statistics survey, public school teachers assign students to use technology in the following manner:

- 61 percent for word processing or creating spreadsheets
- 51 percent for Internet research
- 50 percent for practicing drills
- 50 percent for solving problems and analyzing data

There is little value in teaching a student to use a word processor or the Internet unless the student learns to apply the tool to solve a problem or produce a product. Students need to be using databases to come to some conclusions about a subject and be skilled in using spreadsheets to solve complex math equations.

Effectively using technology in the classroom:

- Keeps children excited about learning in school.
- Creates learning experiences that help students see the relevance of their studies.
- Provides a tool to develop and encourage children to use higher-order thinking.

A secondary divide is forming between schools with inadequate equipment and schools with high-speed multimedia computers, videodisc technology, satellite technology and technical staff to repair and upgrade equipment. Much of the technology in schools today is from an

earlier generation of technology and cannot support the latest programs. Children with up-to-date equipment at home lose interest at school if the equipment is antiquated. Several states, including Utah and West Virginia, have designated funds from state budgets for school district costs for repairing, replacing and upgrading hardware and software purchased with state funds.

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*"Like a pencil, a computer is simply a tool; its real value to a child depends entirely on how it is used."*
— The Children's Partnership

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## Barriers to effective use of technology in schools

Some of the barriers to use of technology identified by teachers in the NCES report include:

- Lack of release time for computer and Internet training
- Lack of time in schedule for students to use computers in class
- Not enough computers
- Lack of good instructional software
- Inadequate training
- Lack of administrative support

Teachers' perceptions of barriers to technology use varied by school characteristics:

- Secondary teachers, teachers in large schools and teachers in city schools were more likely than elementary teachers, teachers in small schools and those in rural schools, to report insufficient supply of computers as a great barrier to effective use.
- Teachers in schools with more than 50 percent minority enrollments were more likely to cite outdated, incompatible or unreliable computers as a great barrier compared to teachers in schools with less than 6 percent minority enrollments (32 percent compared with 22 percent).

## Best practices

### *Suffern, New York*

Viola Elementary School is a fully wired school. Computers with Internet access are not segregated in a computer lab to be used occasionally for drill and practice sessions. Fifth-grade students conduct Internet research on authors using wireless iBook laptop computers. With the use of a rooftop satellite receiver, students in a sixth-grade class compare data from a weather satellite with data from weather Internet sites to track a tropical storm. Students also learn desktop publishing, produce PowerPoint slide shows to supplement their reports, and use Microsoft Excel to create spreadsheets.

Viola has 544 students in kindergarten through sixth grade. They have 22 iBook laptop computers, which are kept on a cart for easy transportation from room to room throughout the day. Each classroom has six PCs, the library has 12 computers and the computer lab has 20 more PCs and a digital video camera that the students use with the Macintosh iMovie program. The Ramapo Central School District, which includes Viola Elementary, has a technology budget of $1 million per year for 4,200 students. Included in the technology budget are salaries for technology coordinators. Teachers' contracts include a clause requiring technology training.

### *Perham School District, Otter Tail County, Minnesota*

The Perham school district is a leader in applying GIS technology in the classroom and the field. Students have been engaged in monitoring the migration of wildlife by assisting state biologists as they track deer and wolves. They use radio transmitted data, global transmission receivers and EPPLviewer 2000 software, which was developed by staff at the Land Management Information Center at Minnesota Planning.

LMIC is working with government GIS managers and teachers statewide to develop a Minnesota environmental atlas that will contain hundreds of maps and overlays to study the interrelationships of ecology, geology, geography, land use and climate, and their effect on people and cultures. The atlas will support learner outcomes and educational standards. The CDs containing the atlas will be distributed free to over 4,000 classrooms.

The EPPLviewer software was originally developed for law enforcement officers for search and rescue efforts. Teachers across the state are discovering this valuable teaching aid and are beginning to incorporate GIS technology in the classroom. It can be downloaded free from Minnesota Planning's LMIC Web site at www.lmic.state.mn.us/.

## Developing technology standards in education

Billions of dollars from government, business and nonprofits have been poured into America's schools for computer equipment, wiring and Internet access during the past 10 years. There is no data on the return on this investment. The National Governor's Association, in partnership with the Milken Foundation, has been involved in activities to improve state action on the integration of technology in reform efforts and to see that teachers are skilled users of technology. Statewide technology standards are recommended for students and educators. These would measure student achievement and ensure that teachers are properly trained to effectively use and incorporate technology into the curriculum.

## Student Standards

The struggle for states and school districts in developing student technology standards is whether they should define and measure learning goals *for technology* or define and measure learning goals *through technology.* According to the Milken Foundation, 36 states have established student standards for technology and nine other states are developing such standards. Of those 36 states, 22 have integrated them into their overall standards for the basic academic areas, six have established separate

technology standards and eight have taken the dual approach.

Because many states have only recently established technology standards, few are fully assessing them. The Milken Foundation recently commissioned a longitudinal study in West Virginia. In 1995, an 11 percent academic gain in mathematics and reading for fifth-graders was directly attributed to technology interventions. Minnesota does not have technology standards included in the current educational standards. However, several school districts have developed their own technology standards.

There are two different frameworks for national student standards for technology education and information literacy:

■ The International Technology Education Association has created the Technology for All Americans Project to develop standards for K-12 technology education. It advocates for technology as a subject as opposed to a vehicle for learning other subjects.

■ The Association of American School Librarians and the Association for Educational Communications and Technology have created standards that focus on information literacy, independent learning and social responsibility.

### What other states are doing

■ North Carolina has developed kindergarten through eighth-grade curriculum, which includes detailed goals, objectives and competencies relating to technology use. The goals and tasks are supported by lesson plans, resource material and suggested software. Beginning in 2001, students must pass a technology assessment measuring their mastery of technology skills in order to graduate. Also, there are established competencies for educators.

■ Oregon has implemented information literacy guidelines. Part one is complete with curriculum goals, content standards and benchmarks for media technology, reading, writing and literature. These standards correlate with the AASL and AECT national standards. Part two, which relates to information literacy through specific curricular areas, is being developed.

■ Illinois standards have integrated technology skills and their assessment throughout subject areas, rather than as a separate curricular area. The standards are embedded in the benchmarks for the curriculum standards rather than as a separate set of competencies.

■ Texas has two student standards pertaining to technology, one that is a stand-alone technology standard and one that is integrated into other subject areas.

### Teacher Standards

Technology standards are being developed in many states to assess technical competencies of teachers. According to the U.S. Department of Education, 20 states reported having technology standards for teachers in place or under development. According to a report by EDvancenet, only 28 percent of teaching colleges require students to learn how to incorporate various technologies into class instruction. Thirty-five states require courses or proficiencies in education technology for those seeking a teaching license and four require courses or proficiencies for recertification. International Technology Education Association Technology Standards for Teachers provide a framework for implementing technology in teaching and learning. Minnesota's standard for teacher licensure requires candidates to use educational technology to broaden student knowledge about technology, to deliver instruction to students at different levels and paces, and to stimulate advanced levels of learning.

However, according to *Education Week*, there is no specific technology training requirement for initial teacher licensure, nor any competency testing. Minnesota also does not require technology training as part of teacher recertification requirements.

### What other states are doing

■ Tennessee used a grant from the U.S. Department of Education Technology Literacy Challenge Fund to challenge K-12 teachers to integrate technology into their teaching using performance-based professional development activities. The 21st Century Training Program offers basic computer training, techniques to integrate technology in curriculum, online resources and access to other learning opportunities.

■ Vermont and North Carolina require new teachers to present a portfolio of technological skills that demonstrates their proficiency.

■ In California, standards for teachers are being developed along with standards for students. Teachers and school administrators will be measured for proficiency on four levels: personal, instructional, mentoring and leadership.

■ North Carolina requires all new teachers to take a state-administered test and complete an interactive activity using technology. Beginning this year, teachers applying for license renewal must have amassed 30 to 50 hours of technology training.

## Final thoughts

Bridging the digital divide in schools and communities is important to Minnesota's future. Access to technology, especially in inner-city schools and rural areas, will provide opportunities for students, the unemployed and underemployed to acquire and maintain the skills they need to succeed. The economic vitality of Minnesota hinges on having a well-trained workforce for the 21st century. Schools, educators, state and local government, businesses and parents must work together to prepare students and citizens to use technology effectively in the global marketplace.

## Glossary

**Broadband:** High-speed transmission. The term is commonly used to refer to communication lines or services at T1 rates (1.544 Mbps) and above. It implies transmitting at higher speeds than the current standard and includes DSL and ISDN.

**Cable modem:** A special modem that uses the cable TV network as a gateway for sending and receiving information.

**Computer-Aided Design:** Using computers to design products, CAD systems are high-speed workstations or desktop computers with CAD software. A graphics tablet is used for drawing, and a scanner may be attached for additional input. The output of a CAD system is either printed or electronically transmitted to a CAM system, which builds the objects.

**Computer-Aided Manufacturing:** The automation of manufacturing systems and techniques, including numerical control, process control, robotics and materials requirements planning.

**Dial-up modem:** A modem that plugs into a telephone line. The fastest modems are 56 kilobits per second.

**Digital Subscriber Loop:** DSL is a high-speed modem technology that operates at 768 kilobytes per second or faster.

**Geographic Information System:** A digital mapping system used for exploration, demographics, dispatching and tracking. Using satellites and aerial photography, the U.S. Geological Survey and other organizations have developed digital maps of most of the world. These maps are processed via software into images that are used for a myriad of explorations and analyses.

**High-speed:** The Federal Communications Commission defines high-speed as broadband service that includes DSL and ISDN technologies at 200 kilobytes per second or greater. The Minnesota Department of Administration defines high-speed as digital service at 256 kilobytes per second or greater.

**Instructional computer:** A computer used solely for student instructional purposes.

**Internet-connected computer:** Any computer that can access the Internet, including noninstructional computers.

**Integrated Services Digital Network:** An international telecommunications standard for providing a digital service from the customer's premises to the dial-up telephone network. ISDN turns one existing wire pair into two channels and four wire pairs into 23 channels for the delivery of voice, data or video.

**Multimedia computer:** A computer with a sound card and a CD-ROM drive with the ability to disseminate information in more than one form, including text, audio, graphics, animated graphics and full-motion video.

**Minnesota Planning** is a state agency that develops long-range plans for the state, stimulates public participation in Minnesota's future and coordinates activities among state agencies, the Minnesota Legislature and other units of government.

The **Critical Issues Team** at Minnesota Planning examines emerging issues that could have a significant effect on Minnesota's governments, its people, economy and natural resources.

*Digital Disconnect: Beyond the infrastructure* was prepared by Lee Schutz and is available on the Minnesota Planning Internet site at www.mnplan.state.mn.us.

Upon request, this document will be made available in an alternate format, such as Braille, large print or audio tape. For TTY, contact Minnesota Relay Service at 800-627-3529 and ask for Minnesota Planning. For additional printed copies, contact:

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