TECHNOLOGY Counts

In Collaboration With
The Milken Exchange
on Education Technology

Schools and Reform in the Information Age
T he need for reporting on the state of school technology is more important than ever. Billions of dollars are being spent each year in an effort to prepare schools and students for tomorrow’s technological demands and challenges. Policies are being developed at every level of government as well as in districts and schools to incorporate more technology into the daily lives of students.

Parents and corporate America are clamoring for schools to move more quickly to embrace a high-tech vision for education. And the fast-changing landscape of educational technology only complicates the task for policymakers and administrators who seek to make “smart” decisions about how to proceed. It’s against this backdrop that we set out late last spring to map the state of educational technology. To guide us in our mapping, we decided to survey the terrain through the perspectives of five “clients” of educational technology: students, teachers, administrators, the public, and policymakers.

What we found is a landscape replete with unexplored and uncharted territory. The problem is basically twofold. First, policymakers and educators are vexed by a lack of data—particularly, comparable state-by-state data—even the most basic questions of the amount of technology already in the schools and how it is used. Second, and perhaps more important, research on whether technology improves student achievement has produced little hard evidence. In the absence of such data and research, teachers, administrators, and policymakers are making decisions based primarily on anecdotal evidence and intuition.

Nonetheless, consensus is growing that an increase in educational technology is not only inevitable but could serve as a powerful tool in the quest to improve the nation’s schools. Technology holds great promise for fostering exploratory learning, empowering teachers, and better equipping administrators.

The task of illuminating complex issues, informing the public debate, and understanding the policymaking process with hard, reliable information is a crucial one, we believe. The bottom line is that lasting school change will only come about when policymakers, practitioners, and parents are armed with the information they need to push for reform.

Technology Counts, then, will serve as the foundation for a series of annual reports that will continue to chart the state of school technology across the 50 states.

--THE EDITORS

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November 10, 1997 - Education Week
Taking Technology’s Measure

By Andrew Trotter

Technology’s stock is flying as high in the nation’s schools as it is on Wall Street. In poll after poll, parents say technology is essential to a child’s education. Many educators believe it’s the missing linchpin of school reform. Business leaders consider it a mandatory part of a student’s preparation for the workplace. And policymakers at every level of government are spending more money on it each year.

With support for technology so strong, people might assume its value for schools has been proven beyond question. In fact, the dividends that educators can expect from this investment are not yet clear.

There is no guarantee that technology improves student achievement. Research in this area has produced little hard evidence, and few studies have yet examined the kinds of technology use that experts believe are most valuable to learning.

Nor is there assurance that policymakers have spent enough time on questions of how the new technology will be used or maintained. Although all the states and many school districts have technology plans, the quality of those plans varies widely. And precious few resources have been spent on ensuring that teachers make effective use of the new tools.

Nevertheless, spending on educational technology this school year could top $5 billion. Proponents of technology acknowledge the many questions that surround its use in schools. But they say technology offers so many potential benefits that it would be even riskier not to invest in it.

“It is impossible for me to imagine how school leaders who are focused on more authentic ways of doing math and science, who are developing rich environments for learning, can achieve that without technology,” says Linda Roberts, the adviser on technology at the Education Commission of the States.

The data may not be perfect,” adds Mary Fulton, an analyst at the Education Commission of the States. “But if we don’t start somewhere and have something to build on, we’re never going to get anywhere.”

In this report, the staff of Education Week has compiled the best data available about the level of technology in the nation’s schools and the latest thinking about how technology should be implemented. Because both are in a state of flux, Technology Counts will serve as the foundation for a series of annual reports in the years to come.

The growing amount of money spent on school technology is not the only factor warranting a closer look at its effectiveness. Technology is also a hot topic in the policy arena.

President Clinton, Vice President Al Gore, and a procession of state governors from both political parties have recently endorsed technology as a necessary tool for education. At last year’s national education summit in Palisades, N.Y., the governors and business leaders who attended made improving education technology one of two main goals for school change.

Among the most important pending federal initiatives are the discounts for telecommunications services that are scheduled to go into effect in January under the Telecommunications Act of 1996. The “E-rate” discounts, which will be administered by the Federal Communications Commission, will be worth $10 billion to schools over the next four years.

Political support for technology has grown, in part, because many policymakers view it as a critical part of broad-based education reform, says Barbara Means, an education researcher at SRI International in Menlo Park, Calif.

“Over the course of five years, a lot of states have come around to seeing technology as an important part of trying to support teachers, trying to get across the new standards,” Means says.

Means and other experts list several ways technology can bolster reform:

- In the classroom, technologies that support exploration, such as the Internet and desktop presentation tools, can create a synergy with “constructivist” teaching methods.
- Providing teachers with high-tech training, personal computers, telephones, and Internet connections is a step toward increasing their professionalism. Technology can reduce their isolation and lead to professional communities of educators in cyberspace.
- Technology can help measure academic achievement as assessments of student performance grow more complex.
- The movement to restructure schools—to decentralized decisionmaking and share it with teachers or school-level councils—can be aided by networks that collect and distribute information. Databases of student information can help teachers target resources and appropriate teaching methods toward individual children.
- Computer tools that streamline administrative tasks can improve school accountability and free up more resources for the classroom.

“We’re not as effective in our reform efforts as we could be if we don’t harness the power of technology,” says Means. “We don’t spend our technology money as well as we could if we don’t implement school reform.”

But reform has many currents—sometimes hard to distinguish as they swirl and eddy, separate and rejoin—and many education reformers consider technology a side issue.

“In school reform, there are so many challenges,”
Means says, “It is so difficult and complex, technology seems another layer of complexity and expense.” Henry Levin, the director of the Accelerated Schools Project, a reform network that seeks to bring at-risk children into the educational mainstream, agrees. “It’s very, very expensive to maintain a [high-tech] facility and someone to watch over it. So that competes with other possibilities.”

Yet, he calls technology a “wonderful tool” when integrated into the instructional program.

“My concern is that the technology ought to basically be the servant of a very strong program that challenges students and gets them involved, as opposed to simply being an entity in itself which somehow is going to have an impact because it exists,” says Levin, an education professor at Stanford University who is on a teaching sabbatical at Teachers College, Columbia University.

Other educators worry that schools are spending money on technology without a clear plan.

“I am very concerned over the rush to purchase hardware when we do not have enough evidence on how best to use computers to help youngsters achieve in reading, mathematics, writing, et cetera,” Samuel G. Sava, the executive director of the National Association of Elementary School Principals, says.

“My second concern is that a number of school systems, in order to purchase the hardware, have begun to eliminate such key programs as the arts,” he adds.

No one admits to sacrificing other programs to technology purchases, Sava says. “But when you talk to music educators, or when you talk to your principals, you begin to get a feel that within the limits of the resources, computers are getting a higher priority. Computers are supposed to support the curriculum, not write the curriculum.”

Strong evidence of technology’s effectiveness undoubtedly would further strengthen public and political support for it. But research is slow in coming.

One difficulty in assembling evidence is that technology’s capabilities have changed faster than educators. Researchers can complete the large-scale, controlled studies that lead to firm conclusions.

Studies of that sort were done on computer-assisted instruction by the early 1990s, and showed that “drill and practice” can effectively reinforce basic skills. But by then, many computer-using teachers were using technology in completely different ways. Other approaches are supported only by small studies or by studies limited to a narrow range of technology.

Some say no one should be surprised. “In most areas of society, we’ve gone ahead on the basis of instinct, not on evidence,” notes Donald M. Feuerstein, a senior adviser in the U.S. Department of Education.

Where proponents of technology lack scientific proof about its benefits, they cite common sense and educators’ classroom observations.

It is often forgotten that the use of technology in the schools has evolved partly through the grassroots efforts of a handful of teachers and administrators who were dissatisfied with traditional teaching methods and who experimented with their classes and schools, sometimes exchanging their own time and money for training.

They gradually won over more colleagues and formed idea-sharing networks and then coalitions of educators—prodded by technology vendors, to be sure—who threw in political support and funding for technology.

Yet, most in education’s own ranks are still more comfortable with chalkboards than with a computer mouse. Only one out of five teachers uses a computer regularly for teaching, according to the National Center for Education Statistics.

Educators and policymakers agree that it is folly to introduce technology without adequate teacher training—both at the university and professional levels.

But budgets and funding often don’t reflect that belief.

“Technology is a special case. It isn’t something teachers got in their preparation,” says Kathleen Fulton, the associate director of the University of Maryland’s Center for Learning and Educational Technology. “We assume teachers know about content and pedagogy, and we expect them to stay up to date in those areas. But they have not been prepared to think about how technology can enhance their teaching.”

In addition to a lack of research, the nation also has a dim picture of the amount of technology that is already in the schools and the ways it is used.

Solid data can make a real difference in public perceptions and in policymaking, exports say. For example, a 1995 NCES survey showed the nation that only 9 percent of school classrooms were wired to the Internet. Coming at a time when the public was becoming intrigued by the World Wide Web, the figure provided a rallying point for the NetDay movement to wire classrooms. The number of wired classrooms rose to 14 percent in the 1996 NCES survey and is expected to jump again this year.

As the states exert more leadership in technology and school reform efforts, they have become especially hungry for data that compare their schools with those in other states.

Legislators ask that question; also, communities
The data may not be perfect. But if we don’t start somewhere and have something to build on, we’re never going to get anywhere.”

Mary Fulton, Policy Analyst, Education Commission of the States

The two companies try to collect data for every school—a method called a “census survey”—because their main business is assembling marketing lists and reports to help other companies target sales efforts.

By default, the companies’ data have generally come to be treated as an unofficial state-by-state scoreboard on technology. That is especially true of data provided by QED, which is better known than MDR.

The problem, say many experts, is that the data are flawed. Henry Jay Becker, a University of California-Irvine education researcher, notes that a census survey is prone to undercounting. He estimates that QED consistently low-balls school technology counts by about 25 percent.

A census survey is “just not a good way of gathering representative information,” he says. “Sample surveys are much better.”

A number of state technology directors and researchers have pointed out other problems with QED’s survey.

Schools generally are under no compulsion to submit data to the company, and in any given year, many don’t bother.

For example, just 6 percent of schools in Rhode Island responded to a survey conducted by QED last spring. The company supplements these data with data collected from Rhode Island schools in earlier surveys, but this practice raises another issue.

As recently as this past summer, QED was still using some data collected in 1994 or earlier—a long time ago, given the fast pace of change in technology. The company tries to minimize this problem, however, by giving more weight to recent data.

For the nation as a whole, QED says it receives data for 67 percent of schools annually, but the response rate varies greatly from state to state.

One way the company boosts response rates is by accepting school data provided by states or districts—even though that practice runs a risk of lowering accuracy.

“A lot of times, districts don’t take [the surveys] seriously,” Cradler says. The wrong person might complete the survey; he might count computers in the warehouse rather than in schools; or he might misinterpret the questions, Cradler says.

In addition, some district technology coordinators say they receive questionnaires at a point in the budget cycle when their estimate of the year’s purchases is hazy at best.

These problems make QED’s state-by-state rankings unreliable, say some state directors.

In its 1997-98 catalog, for example, QED reports Ohio’s student-to-computer ratio as 14-to-1, for a ranking of 43rd in the nation. The ratio of students to multimedia computers is reported at 57-to-1, for a ranking of 46th.

But the data are plain wrong, according to Tim Best, a consultant who serves as Ohio’s technology director. He says that QED did not account for 87,664 multimedia computers purchased by the state over the past two years. The multimedia-computer ratio should be close to 14-to-1, he says.

“Whenever QED figures are released, we get hammered in the press,” Best says. “We spend our time in firefighting rather than doing the work we’re supposed to be doing.”

MDR, which heard from 63 percent of Ohio’s schools in its 1997 survey, reports the state’s ratio in...
The Race Factor
Percentage of 3- to 17-year-olds with home or school computer access, by race and ethnicity.

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November 10, 1997 - Education Week
What Data Should Be Collected?

What gets measured, gets money, some policy analysts say. The flip side—what gets money, gets measured—may be equally true. Perhaps for both reasons, state policymakers are showing greater interest in getting accurate, up-to-date data on technology in public schools.

Many states conduct at least limited surveys of the hardware, software, and infrastructure in their schools, or they glean those data from the surveys of market-data firms. But state officials say they need comparable data from all the states, so leaders can make comparisons and highlight the policies and practices that prove most effective.

Currently, data on school technology are “very fragmented, very scattered, not compiled, not standardized,” says Mary Fulton, a policy analyst at the Education Commission of the States in Denver. She notes that data collected by states are often inconsistent with those collected by other states. “It’s often comparing apples and oranges, cranberries and peanuts,” Fulton says.

One problem is that surveys by different states often don’t use common definitions—such as what constitutes a “modern” computer. A number of states define it as a multimedia computer, meaning it has a sound card and a CD-ROM drive. But Tennessee, for example, defines a modern computer as one with a 386 processor or better and certain networking capabilities.

The market-research firms Quality Education Data and Market Data Retrieval seek to overcome that problem by surveying schools nationwide and breaking out statistics for each state. But many state officials aren’t happy with the quality of these surveys. At the same time, state legislators and education leaders are demanding richer data on the ways in which students, teachers, and administrators are using technology and on the related needs for teacher training and technical support.

Technology experts say that the numbers of computers or wired classrooms don’t necessarily indicate how well teachers and students are using them.

“There is so much equipment in schools that is so underutilized,” says Barbara Means, an education researcher at Stanford Research Institute International. “And there’s some very old equipment in schools that is used creatively.”

Education Week asked state technology directors and various other experts about what school technology information they would like to see collected from all the states. Here are some of their responses:

Students

- What percentage of students use technology to communicate with people beyond their own school or classroom activities?
- What percentage of students use electronic networks, including the Internet, to collaborate on class projects with students at other schools?
- What modes of distance learning are available to students, such as cable television, satellite, or computer?

Teachers

- What percentage of teachers use technology regularly for various activities related to instruction, such as writing, collecting, and analyzing data, and gathering information?
- Do districts or schools maintain ongoing programs of staff development that include technology? What percentage of teachers take part in this type of professional development? How frequently do they participate in them? How many hours do they spend in such programs? How useful do teachers regard them?
- What methods do districts or schools use to encourage teachers to participate in technology training—mandates, incentives, or teacher initiative?

Administrators

- What percentages of principals and superintendents have taken part in professional development on how to integrate technology into the curriculum or to use technology to support school reforms?
- What percentage of official school or district correspondence is distributed via e-mail or Web resources?
- What percentage of teachers use an electronic network for administrative tasks, such as submitting grades, recording attendance, and sending correspondence?
- Is technical support for on-going maintenance of school technology provided by full-time school or district staff, by outside contractors or vendors, or by students?
- What is the ratio of technical support staff to users?
- What percentages of districts and schools have a specific revenue stream to support and sustain technology initiatives?

Outreach

- What percentage of schools facilitate communication with homes by having telephones in every classroom, a homework hotline, voice bulletin, e-mail accounts for teachers, or a Web site?
- What percentage of schools give students access to technology and/or networks during non-class hours?
- What percentage of schools give community members access to technology?

Inventories

- What are the ratios of students to equipment available for instruction, including computers, multimedia computers, CD-ROM players, networked computers, and computers with Internet access?
- What percentages of schools and classrooms have access to cable television, satellite broadcasts, schoolwide local-area networks, and the Internet?
- What types of Internet connections are they (e.g., dial-up, dedicated line, high-speed modem?)?
- What percentage of instructional computers are linked to a local-area network?
- What percentage of district buildings are linked to a wide-area network?
- What percentage of computers are located in computer labs, media centers, administration offices, classrooms, and other locations?
- What percentage of classrooms have telephones?
- What percentage of administrative workstations have LAN or WAN access to the Internet?
- What percentage of schools have access to current word processing, spreadsheet, database, and graphic software?

Continued from Page 8

multimedia computers as 19-to-1, or 34th in its list of states. (Education Week is relying primarily on MDRC’s 1997 survey for state-by-state information in this report because the company accepted data only from individual schools; it disclosed the response rates for every state; and those response rates were comparatively high—averaging 64 percent, with no state below 48 percent.)

Joanne Hayes, the president of QED, acknowledges the validity of states’ concerns. “It’s not an acceptable situation,” she says.

But she also points out that state-collected data often have similar flaws. And she says the company recently retooled itself to work with states to improve data collection.

QED has been trying to enlist states to adopt a common survey of current-year technology use and inventories in their schools. To date, 23 states have joined QED’s Project EdTech and lent their clout to encourage schools to return QED’s surveys. Seventeen more states have shared data they have collected with QED, Hayes says, although she is dissatisfied with the timeliness and consistency of some of it. The company is planning to release the first compilation of EdTech data later this month.

Response rates from the first year of Project EdTech are relatively high, ranging from 41 percent of schools in Arizona to 100 percent in Louisiana, a state that required schools to complete the survey to qualify for a grant. Some state technology directors wonder why they need to rely on a for-profit company when the states have data-gathering mechanisms in place. They want the states to develop jointly their own national survey without the intervention of data marketing firms. Districts tend to take it more seriously if it’s a government survey,” Cradler says.

But Hayes suggests that an independent company is more likely to have fair and consistent survey methodology than 50 different states.

Some researchers, including Becker, downplay the importance of state-by-state comparisons at all. He thinks researchers need to be asking more sophisticated questions that do not lend themselves to the bureaucratic collection procedures of a school census survey—no matter who conducts it.

Data on the numbers of computers, videodisc play-
Momentum is building, meanwhile, for a national research and data-gathering effort on technology. A report released last spring by the President's Committee of Advisers on Science and Technology calls for spending at least $1.5 billion on educational technology research. The CEO Forum, a group of corporate and education leaders, endorsed improved collection of data on schools' use of technology in a report released last month.

One of the experts says the FCC requires schools as a condition of their E-Rate discounts, to submit a technology inventory, their equipment purchase plans, and an assessment of their needs. The Education Department's Feuerstein says the government wants to create a database of the nation's school technology that could be collected over time and analyzed. Feuerstein says the FCC inventory could be joined to a massive NCES effort—in concert with the data efforts of the states—to settle on standards for information collected about school inventories.

Some of the demand for national data is driven by the need to persuade legislators in Congress and the statehouses that their investments in technology have been worth the money. Jonathan Sallet, the chief policy counsel at MCI Communications Corp., warned a group of educators in Los Angeles last spring that the public will want to see the payback.

"Now, there's goodwill and optimism," he said. "Three years from now, we'll need to show results—or in the future [the E-Rate] will be seen as a good idea that failed."

The sections that follow in this report will look at school technology from a variety of perspectives. The first section, on technology in the classroom, discusses what research has revealed about the effectiveness of technology in raising student achievement. The second section, on teacher training, examines how well teachers are prepared to apply technology in their classrooms and their professional lives.

The final section examines how federal and state policies are driving or hindering the use of school technology. The report concludes with a summary of technology efforts in all 50 states.
A Tool for LEARNING

By Debra Viadero

Were it not for the age of the students, this 8th grade language arts classroom could easily be mistaken for a modern office in some sleek, glass-and-steel building downtown. Everyone is working at a computer, the machines arranged in horseshoes of six that fan out from the center of the room like petals on a flower. Each cluster, separated by a padded partition, has its own printer, videodisc player, monitor, and electronic sound-effects board.

Students use the equipment to include sound and film clips in their class presentations or compose music to accompany the blues poems they write. As they read an excerpt from All Things Bright and Beautiful, they can watch videodisc clips on veterinary work on a 9-foot-by-12-foot screen that descends from the ceiling.

Blackstock Middle School, located just north of Los Angeles, has put millions of dollars into 11 “smart” classrooms such as this one under the belief that educational technology improves student achievement. But educators here are hard-pressed to say for sure if the investment has paid off.

Blackstock’s students—most of whom are poor and members of minority groups—are clearly more technologically literate than they used to be. Their teachers say they are also more motivated and spend more time writing and collaborating on projects. And the school won a coveted “Blue Ribbon” from the U.S. Department of Education for its efforts.

“My gut feeling tells me something significant is going on here,” Stephen Carr, the school’s technology coordinator, says.

But is technology helping Blackstock’s children learn more? Educators have no way of knowing. And in that regard, the school’s story is a familiar one.

Tens of billions of dollars have been spent to equip the nation’s schools with calculators, computers, printers, videodisc equipment, satellite technology, televisions, software, and connections to the Internet. The average ratio of students to computers is now 7-to-1, compared with 25-to-1 just a decade ago.

And President Clinton has upped the ante, campaigning for schools “where computers are as much a part of the classroom as blackboards.”

Yet, research on the effectiveness of educational technology offers, at best, mixed results. Some applications have been unquestionable successes; others have yet to prove their mettle.

Ask any expert if technology can improve schooling, and the immediate response is inevitably, “It depends.”

“It’s kind of like asking, ‘Are pencils effective?’ It depends on what you’re going to do with them,” says Ted Hasselbring, a co-director of Vanderbilt University’s Learning and Technology Center in Nashville.

A teacher might use technology poorly, use it well, or not use it at all, he says.

Thus, the real question for educational technology is not “Does it work?” Rather, it’s “When does it work and under what circumstances?”

Educational technology comes in many different forms, from film strips to the Internet. But most of the research has focused on computers.

In the 1960s and 1970s, when they were first introduced to schools, computers were set aside in separate labs. Teachers used them largely to teach stand-alone courses on computer programming.

That effort, it turned out, proved to be a bust. The equipment and programming languages were changing too rapidly for schools to keep up, and students were going out into the work world with outdated skills.

Eventually, however, educators began to view the technology as a more efficient way to provide some of the same instruction they were already providing and to offer practice in basic skills. These programs, for example, might use colorful graphics and cartoon figures to quiz students on simple math equations.

In that regard, the computer’s track record was better.

“Computer tutorials are about as effective as personal tutoring,” says James Kulik, a research scientist at the Center for Research on Learning and Teaching at the University of Michigan. He and his colleagues have reviewed more than 100 studies, each of which compared a classroom using computer-aided instruction with a classroom that did not.

Overall, he concludes, students in the computer-using classrooms learned more and learned it faster. They gained the equivalent of about three months of regular classroom learning—progress that is about par for many kinds of classroom interventions.

“About the only thing we found raising students’ examination performance higher was curricular adjustments made for gifted and talented kids—the kind of thing where kids are taught things beyond their grade level,” Kulik says.

Other studies suggest that computer-based lessons were particularly effective for teaching basic skills to disadvantaged students—partly because they started out in school further behind their more affluent classmates in reading, writing, and arithmetic.

But, as the thinking in the education field changed, it became clear that these kinds of “drill and skill” programs were not enough.

Inspired by the research of cognitive scientists, educators began favoring classroom environments in which students take charge of their own learning, learn to think critically and analytically, work collaboratively, and create products to demonstrate what they have learned. By putting learning in the hands of students, the “constructivist” model turns on its head the old style of schooling in which a teacher...
TECHNOLOGY COUNTS 13

Chris-Craft cabin cruiser that needs fixing up. He
Jasper reads a newspaper advertisement for a 1956
mathematical thinking of students in grades 5 and up.
"The Adventures of Jasper Woodbury," a set of 12
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huge amount of evidence," says Christopher Dede, a
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other educational innovations taking place in the dis-
hard to tell how much of the success was the result of
the equipment and how much could be attributed to
other educational innovations taking place in the dis-
trict's schools at the same time.
"At this point, there are more claims about what
technology can do than there are well-designed eval-
uations with conclusive findings," concludes a draft
report conducted for the U.S. Department of Educa-
tion by the Washington-based American Institutes for
Research.
Part of the problem is that the trend toward con-
structivist learning is relatively new, and technology
has been used to support it only in the past few years.
"There hasn't been enough time to accumulate a
huge amount of evidence," says Christopher Dede, a
senior program director for the National Science
Foundation. "The literature is positive. There's just
less of it."

Every student has access to a computer in this "smart classroom" at Blackstock Middle School in Port Hueneme, Calif. The technology has made students more motivated and willing to collaborate, but no one can say whether they're learning more.

Computers and other kinds of classroom technol-
ogy, it has become increasingly evident, can help
bring about that transformation. But, while there is
no shortage of anecdotes on schools that have suc-
cessfully used technology to reshape teaching and
learning and to raise student achievement, the defin-
itive, large-scale studies that make the case for these
newer, more integrated uses of technology are harder
to find and less clear-cut.

Students in Union City, N.J., for example, made
significant learning gains after the district under-
went an extensive technological conversion. But it's
hard to tell how much of the success was the result of
the equipment and how much could be attributed to
other educational innovations taking place in the dis-

at Blackstock Middle School in Port Hueneme, Calif. The technology has made students more motivated and willing to collaborate, but no one can say whether they're learning more.

One of the few documented successes in using edu-
cational technology to foster constructivist learning is
"The Adventures of Jasper Woodbury," a set of 12
digital adventures designed to improve the
mathematical thinking of students in grades 5 and up.
In one adventure, called "Journey to Cedar Creek,"
Jasper reads a newspaper advertisement for a 1956
Chris-Craft cabin cruiser that needs fixing up. He
takes his aluminum fishing boat to Cedar Creek, where he meets the cruiser's owner. He tries out the
boat, buys it, and then discovers that the running
lights don't work, leaving him 15 minutes to get off the river by sunset.

The challenge to students: Can he make it? The
classes they are in charge of answering this lengthy time-rate-dis-
tance problem, such as the amount of gasoline in the
tank or the distance home, are embedded in the
video. Students must solve at least 15 problems to ar-
rive at a conclusion.

When researchers at Vanderbilt University's
Learning and Technology Center tested the program,
they found that students in Jasper classrooms did as
well as students in traditional classrooms at solving
standard, one-step word problems. But they were sig-
nificantly better than children in the control group at
solving multistep word problems—the kind of com-
plex reasoning that many education reformers say is
so important.
National Geographic Society's Kids Network is an-
other technology-based program with data to back up
its effectiveness.

This program, which is now almost 10 years old,
makes each participating class with nine to 15 oth-
ers around the country via the Internet and a central
computer at the National Geographic Society, the
classes collaborate on eight-week-long research pro-
jects on everything from water quality to recycling.

An independent study of the project involving 36
California schools found that students who partici-
pated in the network outscored students in tradi-
tional classrooms on their grasp of some scientific
concepts. The Kids Network students also outper-
formed control-group students on questions unre-
lated to their unit of study, such as a task that asked
test-takers to interpret bar graphs of children's ice
cream preferences.

Another project, called SimCalc, uses advanced
computer technology to introduce elementary and
middle school students to basic calculus concepts—
what project developer Jim Kaput calls "contextual mathe-
maties of change and the rate of change."

With some of the SimCalc programs, students can cre-
ate mathematical functions to control the movements of
animated characters that they see on their computer
screens. Individual students in a classroom, for example,
can be each in charge of a different character in a
marching band. Students can also use motion sensors
to pick up their own mo-
tions and import that
data into the computer.

University of Massachu-
setts researchers, who are
working on SimCalc in con-
junction with TERC, a Cam-
bridge, Mass., research
firm, have tested their pro-
grams in inner-city middle
schools. SimCalc students,
the researchers found, were
able to perform as well as—
or better than—typical high
school or college-age calcu-
lus students on problems
involving graphical repre-
sentations of motion or that
require the interpretation of
velocity-vs.-time graphs,
among other calculus skills.

"People often think of
technology as doing old
things better," says Kaput,
a math professor at the University of Massachusetts,
Dartmouth. "But we are doing something previously
not thought possible."

Even simple technology, such as word processors
to help in writing instruction, has proved its worth
in the classroom. But again, the circumstances must be
right.

"Where technology is used wisely and where the
teachers are given the right kinds of support and
training and the right kind of equipment, then [they]
are able to actually implement some of the best the-
ory and practice regarding the teaching of writing," says
Stephen Marcus, a co-director of the South
Coast Writing Project and a researcher at the Uni-
versity of California-Santa Barbara. "Students are
more willing to do more editing, to spend more time
reviewing their text and improving it.

"But to provide a computer and think that stu-
dents' writing will somehow magically improve—
that's just wishful thinking," Marcus adds.

Computers and word processors that are poorly
integrated into the curriculum might even distract
students from learning, says Karen Woll, a re-
searcher with SRI International in Menlo Park, Calif.
"I've seen kids spending a whole period illustrating a
color cover of a report, pixel by pixel, when they
haven't even done the report yet," she says.

Teachers also have to be careful not to let the fun
quotient overtake serious learning. A 1996 National
Assessment of Educational Progress survey found
that the most frequent use that 4th graders make of computers is to play games. For 8th graders, playing
games is the second most common use, behind writing
papers. The survey does not specify whether these ac-
tivities took place at home or at school, however.

The recent advent of the Internet presents a whole
new range of issues for educators. Some educators
have compared the Internet to a public library in
Continued on Page 15

November 10, 1997 • Education Week
“There hasn’t been enough time to accumulate a huge amount of evidence [on technology’s effectiveness]. The literature is positive. There’s just less of it.”

Christopher Dede, Senior Program Director, National Science Foundation

Special Assistance

Technology Is Revolutionizing Instruction for Disabled Students

Falls Church, Va.

School has gotten a lot easier for Katherine Montgomery, a 16-year-old junior with cerebral palsy.

The change came about last year thanks to a machine called a DragonDictate, which is produced by Dragon Systems of Newton, Mass.

For Katherine, writing in longhand—and even typing on a computer—is a slow, torturous process. But, with the DragonDictate, she can simply dictate her words directly into a computer and print them out.

She speaks into a microphone mounted on a baseball cap, and the words appear on her computer screen. The process is not instantaneous. Sometimes, the computer mishears a word, and Katherine must select the correct word from a list of similar-sounding choices. But the device has nonetheless cut her homework time dramatically.

“Now, I can turn stuff in on time,” she says.

The DragonDictate, which Katherine shares with four other students here at Falls Church High School, is just one example of how technology has revolutionized schooling for children with disabilities.

With her DragonDictate, Katherine can keep up with her nondisabled classmates. Braille computers and software programs that produce enlarged type do the same for visually impaired students.

Instructional technology can also be a boon for students with learning problems, says Michael Behrmann, the director of the Center for Human Disability at George Mason University.

Researchers at Vanderbilt University in Nashville, for example, have developed a CD-ROM-based program for teaching reading skills that has produced results for both disabled and nondisabled students with low literacy skills.

With the program, known as the Peabody Literacy Program, students watch a video and then read about it. They are guided along the way by what program developers call an “almost-intelligent” tutor. The computer, in other words, takes into account students’ answers and their response time as it “decides” which activity to give them next.

The researchers have tested the program with 5th through 9th graders in Orange County, Fla. In most cases, they found, students had doubled the reading gains they would normally make at their grade levels.

The field of assistive technology experienced a boom in the mid-1980s after Congress revised federal special education law. Advances in computer technology that led to devices that were more powerful, more portable, and sometimes cheaper also fueled the growth.

DragonDictate, for example, has been around for at least a decade, according to William Reeder, the coordinator of integrated technology services in Fairfax County, where Katherine’s school is located.

But, early on, the equipment was complicated and clumsy to use. With more recent versions, however, students can be trained to use the system in about an hour.

Moreover, the price has dropped from about $10,000 in the 1980s to $3,500, Reede says.

The biggest problem, Behrmann says, is finding teachers who are skilled at using the wide range of devices now available.

“If you’ve been in the field 10 years, and you haven’t gone out for additional training, you may have missed this completely,” he says.

—DEBRA VIADERO

11th Graders Boot Up

Percentage of students using computers at school, by frequency of use.

which all the books have fallen down. The challenge for teachers is figuring out how to sift out the information that is educationally worthwhile.

“There’s so much junk on the Net and ‘blue’ stuff that children want to see that it’s going to become a real issue,” Robert Bracewell, an associate professor of educational psychology at McGill University in Montreal, Canada, predicts.

Some schools are responding by supervising students closely and asking students to sign written pledges promising not to use the Internet inappropriately. Others are installing electronic filters to screen out pornographic content.

But Richard Benz, a high school biology teacher in Wickliffe, Ohio, worries that the new buffers may censor out the good with the bad. “If I have students doing research on breast cancer, will that be knocked out because of the word ‘breast’?” he asks.

Veteran Internet educators say that helping students weed out the bad information can become a lesson on critical thinking.

These kinds of uncertainties surrounding classroom computer use only amplify the calls of policymakers for hard data on whether the nation’s investments in educational technology are paying off. But some educators wonder whether traditional tests can really measure what their students get out of the equipment.

Stephen Carr, Blackstock’s technology coordinator, recalls the difficulty he had as a history teacher at the school before he began incorporating technology into his lessons.

“I love history, and I saw that regardless of how enthusiastic and animated I tried to be, I had a tough time engaging 8th grade kids whose hormones are popping all over the place,” Carr says. “But when I used technology to let them discover information on their own, I’d see kids on task.

“It made me realize the measurement that I was using or the state was using or the district was using is perhaps not indicative of what they were really getting from [technology],” Carr says.

Besides, asks Gary Peterson, a California-based educational technology consultant, “How would you assess a multimedia project that is being collaboratively put together by four kids and presented?”

Probably not with a standardized test, he says.

Even performance assessments intended for students to show what they can do with what they know may be missing something if they don’t use technology, says Walt Haney, a researcher at Boston College. In one study, Haney administered a writing task to two groups of middle school students. One group wrote in longhand, while the other typed their essays on computers. All of the essays were then typed and evaluated by independent raters using the same grading criteria. The raters judged the writing samples that were written on computer to be better.

But most performance assessments, according to Haney, ask for handwritten responses from students. He wonders whether they are accurately rating students’ full capabilities.

Haney has asked students for years to draw pictures of their schools and classrooms. Where students once drew a teacher lecturing in front of rows of desks, many are now incorporating computers into their drawings. In one, a student works at a computer while his teacher stands behind him. Out of the teacher’s crayoned mouth comes a cartoon bubble with the words, “Good job!”

The drawing evokes more than the advent of technology in schools. It suggests how computers can change the relationship between students and their teachers. That changing relationship is one of a number of...
“There’s a real misconception that you find a piece of software, you put it on, and you let kids play on it. But teachers have to come up with a pedagogy or a strategy to make it work.”

Stephen Carr, School Technology Coordinator, Blackstock Middle School, Port Hueneme, Calif.

### Putting It All Together

**Integrating Technology Into the Classroom Takes Time, Planning**

Classrooms that use technology wisely and integrate it into the curricula are hard to come by. By his definition, these teachers use computers as a tool to solve problems or to create a product rather than as a reward for completing other work or for skill mastery. They also use the technology to accomplish significant tasks, such as major reports, and for a variety of purposes ranging from simulations to spreadsheets. Such classrooms are rare because integrating technology into schooling is no small task.

“Everything we thought we would do took three times the amount of time we thought it would take,” says Gerry Montgomery, the director of technology for the Monterey Peninsula Unified School District in California. Schools there are two-thirds of the way through an ambitious technology education plan. And Montgomery estimates that it will take a bond issue to complete the work, which calls for wiring every classroom to the Internet, among other improvements.

In Port Hueneme, Calif., Blackstock Middle School’s decade-long effort to incorporate technology has been similarly long and arduous. The process began with a $2.5 million, five-year grant from the state to create a model technology school. With that money and, later, funds from the federal Title I program for disadvantaged children, the school has paid to give a few teachers at a time a year or more leave from regular classroom duties to figure out how technology fits in with their lessons and with state guidelines for teaching their subject matter.

Teachers even worked hand in hand with builders and architects to design their own “smart” classrooms. Much of that time was also spent testing and modifying new technology-based lessons with small groups of students.

“There’s a real misconception that you find a piece of software, you put it on, and you let kids play on it,” says Stephen Carr, the school’s technology coordinator. “But teachers have to come up with a pedagogy or a strategy to make it work. It may not come with an assessment. You have to tweak the software and create ancillary materials.”

Carr’s job was created after equipment breakdowns threatened to discourage his colleagues from using the technology they had.

“It got to a point where teachers expected the technology to work, and if the technology was down, you’d better have somebody get it to work real quick or they were scrapping the technology,” he says.

Eventually, Carr and a core group of other teachers became skilled enough to train their less technology-savvy colleagues. Now, on staff in-service days, teachers can circulate among a number of classrooms where Blackstock’s teachers offer lessons on everything from navigating the Internet to producing computer spreadsheets. The specific topics are determined through surveys of the school’s teaching staff.

Carr also gets help five afternoons a week from two high school seniors who are graduates of Blackstock. John Cradler, an educational technology consultant for Educational Support Systems in San Mateo, Calif., studied 12 California schools that had won hefty technology grants from the state, as Blackstock did. He found that the schools that sustained their investments and continued to use technology well had some features in common. They included:

- A principal and district administrator committed to the project
- A belief on the part of educators that technology is a way to extend the curriculum and to support education reforms—and some knowledge of how to do it.
- The involvement of teachers in schoolwide instructional decisions.
- Adequate allocation of time and money for staff development—on site—and for follow-up support.
- A history of openness to educational innovations.
- A link between technology and district or state curricular standards—and rewritten frameworks to reflect technology’s role.

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### Schools on the Net

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### Computers Across the Curriculum

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**SOURCE:** NAEP Reading, History, Geography Assessment Electronic Data Almanacs, Teacher Questionnaires, National Assessment of Educational Progress, 1994.
side benefits to computer use that have turned up in studies. The existence of these added benefits, technology proponents say, may be further proof that traditional testing methods are not capturing the full extent of the advantages that computer use may bring to the learning process.

In 1985, Apple Computer Inc. provided dozens of schools with a range of technologies, including computers, videodisc players, video cameras, scanners, and CD-ROM drives, and then set out to study the effects. In a summary of that 10-year effort, researchers concluded that students in the technology-rich classrooms performed no better than students in traditional classrooms on standardized achievement tests, but that the classes were reaping other kinds of benefits. Students were writing more and finishing units of study more quickly. They were becoming independent learners and self-starters, working cooperatively, expressing positive attitudes toward the future, and sharing their expertise spontaneously, and representing information in a variety of forms.

And teachers began to act like the teacher in Haney's crayoned drawing—more like coaches and less like lecturers.

“It’s like being a conductor. Sometimes a conductor teaches a particular piece and sometimes he just orchestrates,” Robin Freeman, Blackstock’s principal, says.

Janet Ward Schofield, a psychology professor and senior scientist with the University of Pittsburgh’s Learning Research and Development Center, says the computer almost requires teachers to shed lecture-style teaching.

“As one teacher put it to me, there’s a very high fool quotient,” Schofield says. “Some teachers recognize the fool quotient and were comfortable with it. There were many who were not.”

The classrooms of the latter group continued to operate much like traditional classrooms, Schofield says.

“Everyone thinks it makes you a little bit antiscial,” says Diane Oshiro, the assistant superintendent of telecommunications for the Hawaii Department of Education. “Yes, it will make them antiscial if you’re doing drill and skill, but if you’re using the technology to solve problems, it almost forces that interaction between students and teachers.”

In her state, schools are experimenting with “virtual” classes, offering a select number of Internet courses to schools scattered throughout the Hawaiian islands. Educators found, however, that they had to have an adult on site to guide students through their courses and to keep students from dropping out.

“What we found is that students just needed someone to talk to,” Oshiro says.

Research also points to a change in technology-using students that has long been obvious to

Continued from Page 18

Making the Grade: How Technology Helps One District Meet its Academic Goals

Continued from Page 15

Continued on Page 18
“I’ve seen kids spending a whole period illustrating a color cover of a report, pixel by pixel, when they haven’t even done the report yet.”

Barbara Means, Researcher, SRI International

“Education Week”

Continued from Page 17

teachers: Motivation soars. Study after study suggests that attendance rates have gone up in classrooms where students are using technology for interactive kinds of learning activities. (With basic-skills programs, however, the novelty may wear off after a while.)

One possible reason is that students tend to perceive technology as being less judgmental than their teachers. Students also get excited about creating products that look every bit as polished as things they see in the adult world, experts say.

“You can produce a book with handwriting, but that’s not a book. You can call it that, but students know that it’s not a book in the way adults use books,” McGill’s Bracewell says.

“There’s also a sense in which technology is valued in our culture, and they perceive that, too,” Means of SRI says. “They associate it with high prestige jobs, power, and money.”

While zeal for computers is commonly associated with boys, girls can embrace technology just as wholeheartedly, researchers say. Most of the evidence in this area is anecdotal, however.

“There’s nothing in technology that says girls won’t get involved, it’s the content we impose on it,” says Margaret Honey, the deputy director of the Education Development Center’s Center for Children and Technology in New York.

While girls may not warm to video games that are rife with superhero and violence, they do respond to computer programs in which students determine the content—desktop publishing programs, for example, electronic pen pals, and certain kinds of Internet “mos.” The latter is short for “multi-user object oriented” environments, which allow more than one person to log on at the same time as “characters” and interact with one another.

But the social milieu surrounding the machines can be a deterrent for girls. School computer labs, for example, can turn into “clubs for white boys,” Schofield says.

At the high school she observed, “boys would come and play games together and horse around. Girls would come in and people might not even say hello to them,” Schofield recalls. In the computer programming class at the school, only two of the 15 students were female.

“There were real problems the girls faced in finding a social place for themselves,” she says.

Another benefit of technology, teachers say, is its ability to break down the four walls of the classroom. Through the Internet, students can access information and interact with people thousands of miles away.

“Once you get connected to the world, it brings the world’s issues to the classroom,” says Honey Kern, an English teacher at Cold Spring Harbor High School in New York.

Kern is an adviser for students participating in an Internet-based project on the Holocaust run by the International Education and Resource Network. The project enabled Cold Spring Harbor students to communicate with three Holocaust survivors.

“We sent them questions and they answered us directly on-line,” says Benjamin Goldner, a senior. “This is not something I could have done without a computer. It was simply horrifying and yet amazing to hear firsthand accounts from the lips of survivors.”

The Internet also allows students to conduct research in partnership with scientists. The Cornell Laboratory of Ornithology’s FeederWatch program, for example, enlists students nationwide to monitor the comings and goings of birds at their local bird feeder. The scientists then use the data, which this year they will receive electronically from students in a pilot program, to produce reports on the migration patterns and population declines of winter birds.

And educators in Monterey, Calif., are working with marine scientists on a project called “Virtual Canyon” that will enable students to hypothetically plumb the depths of a deep-water canyon in the Monterey Bay.

The program, a hybrid of CD-ROM and Internet technology, uses a real-life marine research vessel as a metaphor to help students tap into a rich database of information collected by the Monterey Bay Aquarium Research Institute on the bay and its inhabitants.

From the ship’s “moon bay,” for example, students can take “dives” into the ocean. Some dives feature actual video footage taken at depths of thousands of feet by the institute’s remotely operated vehicles. Students can click on a creature they see in the video and learn its scientific name, or they can gather information on salinity, water pressure, and light at various depths of the canyon.

Elsewhere on the ship, the captain, the first mate, and institute scientists can “talk” to students about their jobs and the bay.

“The whole purpose behind this piece is for kids to randomly explore and investigate,” says Kam Matray, the principal investigator for the project, which the Monterey district is spearheading.

Once students have a testable hypothesis, they enter the program’s research section, where they can pose questions, take notes on a notebook, and post their reports on the Internet.

It’s the kind of experience, Matray says, that most students get only on an occasional—maybe even a once-in-a-lifetime—field trip. “Teachers, by themselves, just can’t break down those classroom walls,” she says.

Computer Use in 8th Grade Mathematics

Library Media Centers

Percentage of public school libraries offering various technologies in the 1993-94 school year.

<table>
<thead>
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<th>Technology</th>
<th>Percentage</th>
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Note: Percentages may not total 100 because of rounding.


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Note: Percentages may not total 100 because of rounding.

SOURCE: 1997 Mathematics Assessment, National Assessment of Educational Progress, National Center for Education Statistics.
## Technology and Instruction

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### National Average

|                  | 21 | 55 | 74 | 28 | 66 | 30 | 21 | 70 |

**Sources and notes**

All the data for this table were drawn from research conducted by the firm Market Data Retrieval.

**Students per multimedia computer:** A multimedia computer has a sound card and a CD-ROM drive, components that enable it to make use of cutting-edge educational software.

**Percentage of schools with videodisc players:** A videodisc is an optical disc that contains recorded still images, full-motion video, and sounds in a hypertied environment.

**Percentage of schools with LAN:** A LAN, or Local Area Network, is a network of computers that share resources such as printers, storage, and access to software from a central computer.

**Percentage of schools with WAN:** A WAN, or Wide-area Network, is a computer network in which widely dispersed computers, such as those located in several buildings across a city, are connected.

**Students per CD-ROM:** A CD-ROM, or Compact Disc Read-Only Memory, is an optical-based storage system that permits data (such as music or literature) to be randomly accessed from a disc, stored, copied, or incorporated into a student project.

**Percentage of schools with Internet access:** This figure includes schools with at least one point of Internet access. It doesn’t indicate whether the Internet can be accessed in the school’s classrooms.

**How Market Data Retrieval surveyed and conducted**

From October 1996 to June 1997 all 55,000 public schools in the United States received the I-MER 1997 Technology Survey by either mail or phone. The survey was directed to the school-level technology coordinator by name or title. The first wave of surveying was conducted via a mailing to 55,000 schools in December 1996. The remaining balance of 30,000 schools received the survey via phone calls made from January to June 1997.

Of the 55,000 schools that received the initial mailing, more than 26,000 non-respondent schools received a second mailing in January 1997 and 20,000 non-respondent schools received the survey via the phone. The schools that did not respond to the second mailing also received follow-up phone calls. In total, more than 70,000 phone calls were made. When the surveying was completed in June 1997, roughly 14,000 schools had responded to the mail survey and 41,000 schools had responded to the phone survey.
Teaching the
TEACHERS

By Mary Ann Zehr

Over the past two years, Duncan Hollinger has gone from having no computers in his classroom to having four. He's also gained Internet access and acquired a printer. But he's still teaching pretty much the same way he always has.

"If you have 30 students and four stations, all of a sudden you have to do a lot of redesigning of how to present the material," says Hollinger, a music teacher at LaSalle Middle School in Niagara Falls, N.Y. "You have to change your style of teaching to accommodate or individualize." 

So far, Hollinger says, no one has showed him how. Although the district taught him how to use various computer programs—and even provided him a laptop to practice with—little of that training addressed ways of weaving technology into daily instruction. And he doesn't have the planning time to revamp his lesson plans.

Experiences such as Hollinger's are all too familiar, national education experts say. They warn that a lack of adequate teacher training—or any teacher training at all—could mean that much of the money being spent on hardware and software is going to waste.

"Often, states will spend millions on equipment, and may only spend a fraction—2 or 3 percent—on training," says Glen Bull, an education professor at the Curry School of Education at the University of Virginia. "If you're not training, you're throwing money away."

There is little nationwide data on what percentage of teachers have received technology training, and even less on what form that training has taken. But a 1994 survey by the U.S. Department of Education shows that only 15 percent of the nation's teachers had had at least nine hours of instruction in educational technology.

In part, the dearth of time devoted to training is a result of the lack of funding earmarked for that purpose. If a school's equipment is to be used well, experts generally agree, at least 30 percent of a technology budget should be spent on professional development. In fact, the average figure is just 15 percent, according to a 1993 survey of districts by the research firm Market Data Retrieval.

Bull says administrators and policymakers tend to think they're getting more for their money if it goes for something they can touch, and they can't teach training.

"Clearly, you can show hardware and software to the community," agrees Carol E. Edwards, the director of programs for the National Foundation for the Improvement of Education. Still, she thinks some other issues better explain the lack of funding for teacher training.

"There's some notion that if one spends money on teacher training, you're taking it away from direct spending on students," she says. In addition, Edwards says, many people believe that teachers ought to pay for their own training. "There's something about that old factory model that says, 'If you want to learn, you need to go out and do it on your own, and, if you're lucky, you might become a supervisor or manager.'"

Of course, just because a district pays for training doesn't mean it will be effective.

A poll of 582 teachers conducted this year by the Global Strategy Group for Jostens Learning Corp. found that 71 percent of the respondents said basic computer training was available. The proportion dropped to 48 percent when respondents were asked whether they had access to training for integrating computers into classroom instruction.

"If you told me how many courses I've taken in computers, you would roll on the floor," says Bonnie Bracey, an Arlington, Va., teacher who was appointed by President Clinton to a federal panel on information technology from 1993 to 1995. 

The problem is, those courses had "no connection to what I teach," she adds. "It took us a long time to figure that out."

Indeed, experts in instructional technology say, as the Internet and educational software become a larger part of daily school life, teachers need to adjust to no longer being the sole source of information for their students. In many cases, teachers might be less familiar with the technology than their students.

Teachers who use technology also must learn how to manage their classrooms differently. They need to become more comfortable with different students doing different activities at the same time, and they may not be sure of their students—not just those who feel confident with technology—have a chance to use it.

"We're taking teachers and trying to transform them into something very different than what they signed up for," says Michael R. Haney, a program director for funding teacher training projects at the National Science Foundation.

Haney offers himself as an example, saying he went into teaching years ago because he liked giving a lecture and having a stage presence. "There was nothing about my training that taught me how to have kids go in eight different directions," he says.

Technology training would be more effective if teachers themselves were involved in planning it, but they usually have no more than a token role, says Larry Cuban, a professor of education at Stanford University.

"The way that training is being framed," he says, "is that teachers need to be trained in order for computers to be used in classrooms, and if teachers aren't using computers, then it's the teachers' fault." Administrators and policymakers are often worried most about getting the equipment into the schools as soon as possible, Cuban says, while teach-
ers have practical questions, such as how the technology should be incorporated into the curriculum. "Whose questions are going to be heard—the administra-tors' or the teachers?" he asks rhetorically. Larry Martinez, the administrator for school technology and information services for the Niagara Falls district, where Hollinger works, isn't blind to the charges that teacher training hasn't included enough practical applications for the classroom. But he responds that it's been hard to get teachers to share information about what they teach so he can make the training more relevant. And, he says, some teachers expect technology to do too much. "Teachers seem to want a perfect package—a perfect 7th-grade software program for blond-haired, blue-eyed students—and it's not going to happen," Martinez says.

The need for training is particularly strong among veteran teachers who earned their certificates years before the personal computer entered the market. In the 1993-94 school year, the most recent year for which data are available, 24 percent of elementary public school teachers and 26 percent of secondary teachers were 50 or over, according to the National Center for Education Statistics. Nearly a third of the teaching force had been teaching for more than 20 years. But even many young teachers who are familiar with technology don't know how to use it in a classroom. "I couldn't even tell you some computer programs that would help a child with reading or math," says 23-year-old Kathy Nestor, a special education teacher at Hood School in Lynn, Mass. She expects to receive a new Apple computer with a CD-ROM this year for her class and says she'll "definitely need training." Martinez says.

Duncan Hollinger, a teacher in Niagara Falls, N.Y., has Internet access and four computers in his classroom but little training on how to teach with them. "All of a sudden you have to do a lot of redesigning of how to present the material," he says.

Nestor didn't have any technology training at St. Timothy's School, from which she received degrees in English and special education in May 1996. She recalls that only once—in a course about testing—did a professor tell students about the use of technology in education. Norma Horan, a principal for St. Timothy's School in Columbus, Ohio, interviewed 30 people for five teaching positions at her school this year. The candidates were mostly young recent graduates from state universities. During interviews, she says, "I ask them to rate their level of computer knowledge. Most respond either 'non-user' or 'beginner.' Very rarely do I get someone who says very comfortable." Kathleen Fulton, the associate director of the University of Maryland's Center for Learning and Educational Technology, says colleges of education have been slow to integrate technology into their own curricula, in part, because many faculty members are too removed from K-12 classrooms. "Most of the innovation in technology is at the K-12 level, not in higher education," says Fulton, who was a senior analyst and project director for the now-defunct congressional Office of Technology Assessment. A May 1996 survey of schools of education shows that only 45 percent of faculty regularly used computers, televisions, and VCRs as interactive instructional tools during class periods; 53 percent occasionally used some electronic technology to present information in class. Fifty-eight percent of schools of education didn't have any classrooms wired for the Internet; 39 percent had no World Wide Web site. The survey was conducted by the American Association of Colleges for Teacher Education and the National Council for Accreditation of Teacher Education of their 744 member institutions. NCATE hopes to increase these figures by requiring schools to meet technology standards for accreditation after the year 2000. "We want to see technology move from the periphery to the center of teacher education," says Arthur E. Wise, the president of NCATE, which accredits about 40 percent of the nation's schools of education.

A report released in September by an NCATE task force offers recommendations for what the new technology standards should entail. It says, for instance, that colleges of education must be required to show how the role of technology is part of their main plan for teacher preparation. "We are seeing this report as a way to send a signal well in advance," Wise says.

One school that ranks among the current leaders in technology training is the University of Washing-ton. The university requires all its education majors to take a course in basic computer skills or test out of it. Faculty mem-

eral consensus among the current leaders in technology training is that colleges of education, says it's more complex than most people think to merge technology skills with teaching and learning. "The fact is that not a lot of people know how to use technology as effective instruction," he says. Glen Bull says it's taken the faculty at the University of Virginia's Curry School of Education a long time to figure out how to integrate technology into the curriculum without it seeming contrived. In fact, a committee has met twice a month since 1977 to identify how best to integrate technology into the teacher education curriculum. Nearly all members of the education faculty make use of technology in their courses, Bull says. All education majors there are required to take a course that introduces them to the broad range of technologies they might use for instruction.

Colleges of education in North Carolina and California, meanwhile, will soon be required to empha-size technology. Beginning in the spring of 1999, all teacher candidates coming from North Carolina schools of education will have to pass a state test in computer com-petency. In addition, all veteran teachers renewing their license will be required to earn three to five credits in technology. "We're always doing staff development if the people coming out of the universities aren't trained," says Elsie L. Brumback, the director of instructional technology for the North Carolina Department of Public Instruction.

In California, legislators recently passed a law requiring that, after Jan. 1, 2000, a teaching credential will be contingent on "demonstration of basic competency in the use of computers in the classroom." To receive a permanent credential, which teachers are eligible for after five years, they will have to study advanced computer-based technology.

Research shows that training is most successful when it offers hands-on learning, opportunities to ex-

Continued on Page 26

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experiment, and easy access to equipment and people who can explain how to use technology well in the classroom, according to "Teachers & Technology: Making the Connection," a key 1995 report by the Office of Technology Assessment.

Once teachers are certified, they’re lucky if they can find the time for any training at all, some experts say. According to a 1996 survey of public school teachers by the National Education Association, secondary teachers have an average of five class periods a week for preparation; 10.6 percent of secondary teachers have no designated preparation time. Elementary teachers average less than three hours a week of preparation time; 8.2 percent have no preparation time.

"Professional development is the biggest bottleneck to the implementation of new technology in schools, and the reason is that teachers are so busy," says John D. Bransford, a professor of psychology at Vanderbilt University and a co-director of the Learning Technology Center at Vanderbilt’s Peabody College. As part of a team that included a publishing company, Bransford helped create a reading series, called Little Planet, that uses videodiscs and computer software. His experiences with that project showed him the importance of providing time for training.

The team worked closely last school year with nine teachers who used Little Planet in their classrooms. Vanderbilt researchers met with the teachers for an entire day twice a month and also visited their classrooms regularly. A research grant covered the cost of substitutes at the teachers' schools.

Given such support, three teachers interviewed recently said they felt they were successful in integrating the program into their curriculum, and they raved about the student response.

On the other hand, a few teachers who weren’t part of the pilot group, and were trained on how to use the series only during a one-day session over the summer of 1996, were less enthusiastic.

Little Planet Publishing had provided the materials and training for free to 30 Nashville teachers. But six weeks after the one-day session, the company called the participants and found that "a disturbing number of people hadn’t even opened the box," says Paul Sloan, the chairman of the company.

Over the course of the school year, Sloan had his staff visit the teachers’ classrooms and help them teach the series or fix technical problems with their computers. By the end of the year, 20 of the teachers were using the series extensively, though five teachers still had not used it at all.

Districts providing their own professional development have experimented with various ways to go about it.

At Barnwell Elementary School in Alpharetta, Ga., technology specialist Diane Stephenson offers teachers an optional training session every week for an hour after school. She usually reviews one piece of software and gives teachers the chance to brainstorm how they might use it in their classes. "After teaching all day, it’s about all they can take," she says.

Dare County schools in North Carolina have a more top-down approach. Four years ago, Superintendent Leon Hölleman informed teachers and principals that they would have to reach a basic level of computer competency within the next year if they wanted to keep their jobs. A basic level included knowing how to use the Windows operating system, do word processing, and create and use spreadsheets and databases. Training was provided by knowledgeable teachers during in-service days.

"People were really upset. They would cry and beg not to do it," says Landra Cartwright, the technology coordinator for the district, who designed the plan. But everyone met the requirements, even one teacher who had to take the classes four times, Cartwright says. Afterward, the teachers were given laptop computers that they could use in school or at home.
I have become the de facto Internet expert and fix-it guy and the research guy. I relish that role, but it’s very time-consuming. It’s hard to be an effective teacher and trouble-shooter."

George Cassutto, Teacher, North Hagerstown (Md.) High School

An ‘Underused’ Resource

During the 1994-95 school year, the district began requiring teachers to take 20 additional hours of technology training each year if they wanted to qualify for any of the district’s schools in North Dakota do not make technology competency a formal part of performance evaluation. The Grand Forks school district in North Dakota is using a different approach to training, also with good results. Seven teachers have taken a two-year paid leave of absence to work directly with teachers. "We don't want to have that little-old-lady-in-tennis-shoes-image," says Mary Ann Zahr.

Library Media Specialists Are Often Experts on Technology

Library media specialists can be a big help to teachers who want to learn more about technology, three experts who have experience in the position say. "They're underused," says Kathy Schrock, a former library media specialist who was hired last February to oversee technology for the Dennis-Yarmouth Regional School District in South Yarmouth, Mass. Schrock manages a World Wide Web site for educators that is popular among teachers nationwide.

"What teachers don't realize is that librarians have been trained on how to search and how to evaluate" information, she says. Most of the nation's schools—93.7 percent—have a library media specialist, according to the American Association of School Librarians. The nation has 97,976 library media specialists.

Educational technology is often concentrated in a school's library. Schools with only one Internet connection frequently have it there, and many school library collections contain CD-ROMs and software programs as well as books. In Madison, Wis., the district librarians have put together an electronic library of Web sites, organized by subject. In addition, they are trying to teach students and teachers better search skills, which are more important now than when a library's resources were all pre-selected.

"We're very concerned about the time teachers and students waste on the Internet," says Madge Klaas, a former school librarian who is now a program support teacher for the Madison district's 46 school libraries. Library media specialists feel much the same pressure that teachers do to get up to speed on educational technology.

A School Library Journal survey found that in the 1993-94 school year, 75 percent of respondents said they'd had training on instructional design/consulting with teachers within the previous two years, 71 percent had received training in integration of information/computer skills into curricular areas, and 40 percent had participated in Internet in-service training. Respondents said they had participated in other kinds of technology training as well, including CD-ROM technology and on-line searching.

Librarians also are usually the only people in a school who have been trained in copyright law. Schrock says that when she gives talks about copyright laws pertaining to electronic publishing, some teachers turn their eyes downward because they realize they're not seeking proper permission to use information from the Internet. These areas of expertise should encourage media specialists to break down the walls that divide libraries and classrooms, believes Carol Simpson, a former school librarian now in charge of library technology in the Mesquite Independent School District in Texas. The library should be a resource center that is always open to students, she says, and, in turn, librarians should venture into classrooms to work directly with teachers. "Most educators still have the mindset of the library when they were in school," Simpson says. "The librarian is a clerk: check out, check in. Their curriculum experience goes unused. "We don't want to have that little-old-lady-in-tennis-shoes-image." —MARY ANN ZAHN

At the Dennis-Yarmouth Regional School District in South Yarmouth, Mass., former library media specialist Kathy Schrock is responsible for coaching and training teachers, providing technical support, and evaluating and ordering educational software for eight schools. "I'd like to spend most of her time coaching teachers on curriculum. "I hope things will change," she says.

"In other instances, schools ask teachers who are comfortable with technology to help their peers on curriculum issues while juggling their other responsibilities. Sometimes, the schools offer stipends or re-release time to such teachers, but not always. "I did two jobs last year," says Dawn Caldarrella, a teacher at West Lawn Elementary School in Falls Church, Va. Requests from other teachers for advice got out of hand, she says, so her principal hired her this year to serve as a technology resource teacher and to provide technical support on a full-time basis. The school had to give up a teacher position to do so.

"We're very concerned about the time teachers and students waste on the Internet," says Madge Klaas of Madison, Wis.

In addition to a lack of funding and planning time, another obstacle to training can be a reluctance on the part of some teachers to embrace new technology. "Some teachers are plain not interested and aren't going to change no matter what," says Diane Stephenson, who decided not to force teachers to attend her technology training sessions after she initially required it.

"I don't think technology can be imposed on teachers," agrees Libby Adams, a computer resource teacher at Troost Communications Academy in Kansas City, Mo. She'd like to spend most of her time coaching teachers on curriculum. "I hope things will change," she says. Other teachers are reluctant to use technology because they are ambivalent about its benefits. "Our use of and emphasis on technology, especially for children and adolescents, has simply taught them to want everything faster," says Marya D. Fitzgerald, an English teacher at Robert E. Lee High School in Springfield, Va. While she uses a laptop to record grades and has students use a computer for word processing when working on the..."
school literary magazine, she says she gets concerned when students tell her they don’t like to read because “it’s too slow.” She thinks students ought to be taught how to do things “the slow way” first.

But on the whole, teachers value technology. In a poll conducted this year by Peter D. Hart Research Associates Inc. for the Milken Exchange on Education Technology, teachers were asked to use a 10-point scale to rate the importance of student access to computers, with 10 meaning “extremely important.” Ninety-two percent of the respondents recorded an 8 or higher when asked about high school students’ access; 68 percent recorded an 8 or higher when asked about elementary school students’ access.

For Sondra Burke, a 2nd grade teacher at Barnwell Elementary School, the turning point was learning about high-quality educational software. “We didn’t know what was out there,” Burke says. “Once you know what’s out there and how it can help the children, you jump at it. And once they show you how easy it is, you go for the gold.”

Teachers who are excited about integrating technology into the curriculum say a supportive school culture is essential.

Kristi Rennebohm Franz, a 1st and 2nd grade teacher at Sunnyside Elementary School in Pullman, Wash., recalls how her principal and colleagues backed her when she decided she wanted to experiment with telecommunications projects. “They found a Mac LC for me. They found a modem and got me set up. The custodian helped me run wires from the main office to my room so I could use the dedicated line. The secretary let me know when I could use the dedicated line.”

Her experiments have sparked enough interest in telecommunications that her whole school has participated in technology projects.

Henry Jay Becker, a researcher at the University of California, Irvine, cites four factors in the teaching environment that tend to encourage the use of computers: collegiality among computer users; resources available for staff development and computer coordination; smaller class sizes; and school support for using computers for meaningful activities, such as producing the school newspaper and yearbook.

Becker estimates that to create such an environment would cost $1,375 per pupil per year.
It’s an ideal, but my assumption is that unless you do this you won’t have a full teaching force of exemplary computer-using teachers,” he says.

Some teachers are having to make the best of school cultures that provide little support. Mary Jane Christopherson teaches students how to create and analyze digital images at Chatfield High School in rural Minnesota even though she feels her technology expertise isn’t appreciated by colleagues or administrators.

“It has been a lonely battle and one I’ve thought about giving up,” says Christopherson, who learned how to use image-processing software for teaching science through a weeklong course offered in Rochester, Minn., by the Arizona-based Center for Image Processing in Education. “It is high stress because things break. You ask yourself, ‘why bother?’”

In the end, she says, she bothers for the sake of her students.

George Cassutto, a 9th grade government teacher in Hagerstown, Md., knows the feeling. He’s the only teacher in the 1,200-student North Hagerstown High School who teaches with technology. Last summer, he and one of his students received an award from a software-development company, EdView Inc., for a World Wide Web site on the civil rights movement.

“I have become the de facto Internet expert and the fix-it guy and the research guy. I relish that role, but it’s very time-consuming. It’s hard to be an effective teacher and trouble-shooter,” says Cas- sutto, who asked his principal if he could have a technology planning period for this school year; he didn’t receive it.

Teachers on the Web

Selected World Wide Web sites for teachers seeking advice on how to use technology in instruction:


■ All Tucker’s Lesson Plans provides lesson plans for using the Internet that have been designed by teachers and organized by content area. See www.tms.nla.gov.

■ Global SchooNet Foundation helps teachers who want to get their classes involved in telecommunications projects. It lists hundreds of projects that have been conducted or are under way. See www.gen.org/index.html.

■ Educast delivers personalized education news and Web links to teachers according to a profile of their interests. It also lists information about grants and free resources. See www.educast.com.

■ Multimedia Resources Free for the Taking is a compilation of pictures, videos, sounds, and other useful tools that teachers can use from the Internet for multimedia projects. See www.thc.uchicago.edu/edfields.htm.

■ The Eisenhower National Clearinghouse for Mathematics and Science Education highlights outstanding Web resources for math and science teachers under its Digital Dozen list. See www.enc.org/classroom/index.htm.

■ TeachNet includes descriptions of more than 500 classroom projects (not necessarily using technology) designed by teachers. See www.teachnet.org.

T E C H N O L O G Y C O U N T S  

Teachers who had at least 5 hours of training in educational technology in 1994: The data are drawn from the U.S. Department of Education’s “1993-94 Schools and Staffing Survey.”

Instructional computers by location (classroom and laboratory): Many states have asked schools to indicate the percentage of their computers located in the classroom, laboratory, library, or other location. The data presented here reflect information about the two most popular locations: the classroom and laboratory. (See note on MTRA’s methodology, Page 20.)

Involving Teachers

<table>
<thead>
<tr>
<th>State</th>
<th>Teacher license requires technology training</th>
<th>% of teachers who had at least 6 hours of technology training</th>
<th>Instructional computers by location</th>
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Managing the use of school technology poses a host of vexing issues for administrators. The trick is weeding through the jargon and hype to decide how best to proceed.

By Andrew Trotter

As technology flows ever faster into the nation's schools, many administrators say they're feeling swamped by the challenges of putting it into place.

"We're getting kids coming into our system—even at kindergarten—who are pretty knowledgeable with computers," says Allen Rosenthal, the superintendent of the Sun Prairie Area School District, near Madison, Wis. "There's a real pressure on us to put technology at the top of our agenda."

It's a pressure that most administrators would rather avoid, some members of the profession say. While superintendents tend to support technology, according to polls, they turn wary once they discover how much it changes the traditional school culture, according to James Tice, the superintendent of the Strafford, Mo., schools.

"We are bodies at rest that are wanting to stay at rest," Tice says of his colleagues. "Administratively, we've got it perfected. We've got kids lined up in desks, we ring bells, and they change classes."

But when superintendents see children sprawled on the floor around a computer working on a group project, or to have evaluate technology-using teachers, or even imagine telephones in every classroom, they don't know how to act, Tice adds.

Technology presents a range of difficult management issues for administrators. What kind of administrative uses of technology with instructional uses?

Plenty of information is available on these vexing subjects from school staff, the Internet, government and professional organizations, trade publications, and vendors. But good advice is often buried under a mound of hype and jargon, and opinions abound about the best ways to proceed.

"In working with districts around the country over the last five to 10 years, I have been struck by how very uneven technology use can be," says Walt Haney, an education professor who teaches a course titled "Expectations and Evidence for Educational Technology" at Boston College. "A district can be state of the art in its research unit but at ground zero regarding instructional applications, or the reverse."

Even high-tech districts differ from one another. "If you look at the leading-edge school districts, every one is doing things a little differently," says Steven P. Langbear, the educational technology coordinator for the Versana, Wis., school district, which has given every student from grades 3 to 12 an e-mail account.

Some administrators have been hesitant to commit to technology because they've seen how hard it is to avoid costly mistakes. Still fresh are instances of officials who have overspent on communications systems that vastly exceeded their needs; who bet on technologies that were "orphaned" by manufacturers; who neglected to seek input from teachers; and who exhausted their budgets on equipment, leaving nothing for staff training.

Rosenthal describes technology as "one of the most frustrating challenges" of his nine years in Sun Prairie. "We know what the need is, but meeting that need and juggling it with all the competing priorities is tough."

Experts say there is a link between administrators' ability to make informed technology decisions and their personal use of technology.

A superintendent who has a computer in his office and uses it "is more willing to invest in a [technology] plan and is more aware in general of his staff members' needs," says consultant Judy Stainback, who assists Tice's district.

Linda C. Wing, the coordinator of Harvard University's Urban Superintendents Program, agrees. "A lot of people experience changes in their lives using technology, and then they know children can do it, too."

Nearly three-fourths of school superintendents nationally use computers, according to one survey, but observers have mixed impressions of administrators' command of technology.

"An increasing number of [administrators] are becoming technologically literate, but it's still a small percentage," says Paul Houston, the executive director of the American Association of School Administrators.

Craig Richards, a professor in the graduate program for school administrators at Teachers College, Columbia University in New York City, guesses that only 5 percent of principals nationwide are fluent in the basics of word processing, spreadsheets, and presentation software.

The reasons include the administrators' age, schedules that are too busy to allow time for training, and, for some school leaders, a reluctance to give up the perquisite of having a secretary do the typing.

"Principals, on average, are 50 years old," Richards says. "We've got a generation of people who are actually barriers to the infusion of technology in school systems—and are afraid of it themselves."

Other observers see signs of progress. "It's not a dismal picture," says John R. Hoyle, a professor of educational administration at Texas A&M University. "There are some individuals who refuse to turn their computers on, but I see more of the older guys, ages 40 to 60, surfing the Web."

Hoyle notes that the level of computer skills varies with the job title: A superintendent may only know word processing, but the chief finance officer probably understands spreadsheets, too.

Whatever the reasons for lagging technology
skills, they do not include lack of access. Administrators commonly have a modern computer on their desk, and they tend to get e-mail accounts and access to the Internet before teachers and students, says Jerry Malitz, a project director at the National Center for Education Statistics in Washington. A fall 1996 NCES technology survey found that 92 percent of Internet-connected schools make the Internet available to administrative staff, compared with 88 percent that provide the Internet to teachers and 35 percent that provide it to students.

To boost administrators’ skills, some districts have required administrators to attend computer survival courses. In Strafford, Mo., Tice has made technology know-how count in awarding administrative promotions.

And a number of graduate programs—such as the education specialist program at Northeast Louisiana University—demand that candidates for degrees in school administration must take a technology course—a rare requirement five years ago. “Technology needs to be acknowledged [in credentialing],” says Gary Marx, the AASA’s deputy executive director. “The credentialing processes change more slowly than the world around us. That’s frustrating to school administrators who feel that preparation needs to be adequate.”

Interest in adding technology requirements was spurred by an AASA commission proposal for professional standards developed in 1993, says Hoyle, who served—or been reappointed—to the AASA, says the rap-proposal for superintendents. For the 63,000-student district and how technology can have mixed results, as in the 4,600-student Sun Prairie district, where schools media specialist Pat While such efforts can give superintendents a broad grasp of technology, district leaders should rely on specialists for technical advice, school officials recommend.

Jesse Rodriguez, the director of information technologies for the Tucson, Ariz., district, and Paul Houston of the AASA have a common understanding of how a collaboration can work. Rodriguez served under Houston when Houston was the Tucson superintendent, from 1986 to 1991. Houston says he had basic computer skills but little experience in large-scale technological change when he arrived in the post. He turned to Rodriguez for advice on buying a computer system to anchor the district’s information functions.

"I had to make a decision between a mainframe and a [network]," Houston says. "We were ready to spend several million dollars." At the time, he adds, "there were powerful forces arrayed pushing the mainframe solution.”

Rodriguez helped him clarify what his goals were for the 63,000-student district and how technology could advance them, Houston says. They avoided getting sidetracked into debates about, say, the merits of Apple computers vs. IBM. “Rodriguez would constantly say, ‘What do we want to happen?’” Houston recalls. Together, they agreed that a network-based system mirrored the kind of district Houston wanted. Many districts are taking a similar approach more than a decade later. Lewis A. Rhodes, a consultant and a former assistant executive director at the AASA, says the rapport between Houston and Rodriguez is “a perfect model,” but adds that “you don’t find that much.”

Unfortunately, Rhodes says, many district technology experts are isolated in management-information systems departments and are not consulted on governance and instructional issues. “They aren’t brought in to important conversations,” Rhodes says. “They’re just talking to themselves.”

One leadership test that looms in some administrators’ minds is how to provide upgrades and technical support for school technology. Districts have tended—or been required—to spend money from bonds and state grants on buying equipment, while they often have underestimated or omitted ongoing support costs in their budget forecasts. Increasingly, districts are providing Internet access through a network, which requires more sophisticated support than a single modem connection. Greater dependence on networks and computers for basic functions raises the stakes if the equipment breaks down. Most experts say it’s essential to have technical experts on staff. Many schools that have wide-area networks still rely on part-time network administrators, but the share fell from 51 percent in 1994 to 42 percent in 1996, according to the NCES. The share of schools with full-time network administrators, meanwhile, climbed from 9 percent to 29 percent. Another 29 percent of schools with wide-area networks still held “no single individual” serving as a network administrator, however. Such schools may be relying on a combination of district and school personnel and outside vendors.

A nationwide shortage of informational-technology specialists is making it more difficult to hire qualified people. “Technical specialists are becoming hard to find,” says Cheryl Williams, the director of the Institute for the Transfer of Technology to Education, at the National School Boards Association. Money is also a factor. Large and better-funded districts can generally afford to hire a small, if overburdened, technical staff. But small districts and those that are just scraping by financially tell a different story. In some Missouri districts, the only technical support is a toll-free phone number, consultant Stainback says.

“Districts’ typical strategy has been to grow their own expertise by training teachers or media specialists who have technical aptitude. That approach can have mixed results, as in the 4,600-student Sun Prairie district, where school media specialist Pat

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“Principals, on average, are 50 years old. We’ve got a generation of people who are barriers to the infusion of technology in school systems—and are afraid of it themselves.”

Craig Richards, Professor, Teachers College, Columbia University

Where To Find Help

Experts Offer Advice, Resources For Managing School Technology

Technology doesn’t change the basics of school leadership—just a few important details, say seasoned administrators and other experts who have pondered the terrain ahead. Here’s some of their advice:

- Set your goals first, then consider tools. Otherwise, technology vendors will urge you to adopt goals that fit what they have to sell, says Gerald Maltz, a project director at the National Center for Education Statistics at the U.S. Department of Education. “You don’t want to buy a technology solution. You want to help design a functional solution,” he says.

- Make the technology plan a part of the overall improvement plan for the school or district.

- Connect instruction and management. Improving instruction may be paramount, but technology that improves management can raise the capacity of schools to provide instruction, says Lewis A. Rhodes, a consultant to the American Association of School Administrators.

- Connect people. Administrators and teachers benefit from understanding more of each other’s needs and perspectives. Infrastructure that moves information between those groups—telephone, e-mail, and data networks—can increase the organization’s efficiency, Rhodes says.

- Include others in the decision-making process. Technology is multifaceted, and each potential group of users—administrators, teachers, students, parents, and community members—can contribute insight and support that will improve the odds of success.

- Learn technology personally. From your own use of technology—at home or at the office—you can learn to think beyond the individual bits of equipment to lessons about how technology can shape and serve an overall system of education.

Key Resources

Administrators seeking advice on tasking technology questions can tap into plenty of sources:

- “Technology @ Your Fingertips: A Guide To Implementing Technology Solutions for Education Agencies and Institutions” offers “down-to-earth advice on every aspect of school technology leadership, compiled by the National Cooperative Education Statistics System. For information on ordering the report, call the National Library of Education at (800) 424-1616.”

- “Maximizing Your E-Rate Workbook” offers tips on the pending federal discounts on telecommunications services for schools and libraries. Developed by the Consortium for School Networking and the American Association of School Administrators, the book costs $55 for members, plus shipping and handling.

- “The Technology Leadership Network of the National School Boards Association helps more than 300 school districts share information and expertise on technology—through meetings, special reports, and a newsletter. For information, write to NISPA, 1680 Duke St., Alexandria, VA 22314; (703) 838-NSBA; Web site: www.nsba.org/itsa.”

- “The U.S. Department of Education offers the latest information on the E-Rate at the Web site www.ed.gov/Technology.”

- “Excellence & Accountability in Teaching: A Guide to U.S. Department of Education Programs and Resources” describes a range of resources that the Education Department makes available to support school improvement and technology, including the Dwight D. Eisenhower Professional Development Programs, the Technology Literacy Challenge Fund, grant programs, technical assistance centers, and clearinghouses. For a free copy, call (800) USA-LEARN.

- The National Network of Regional Educational Labs consists of 10 regional educational labs, supported by the federal government, which offer extensive resources for school leaders. Find them on the Web: www.nrel.org/national—ANDREW TROTTER.

Continued From Page 31

Wende served for three years as the technology coordinator.

Wende says the part-time job included technology planning, equipment purchasing, training teachers, and loading software on hundreds of individual computers. “I was also in charge of a whole library media program,” she says.

And being spread thin wasn’t the worst of it. “She became a lightning rod and the middle person for some real political struggles” over technology funding, debates over computer platforms, and computer donations, superintendent Rosebenthal says. Last summer, she returned full-time to her media center job.

David S. Glaser, the chief financial officer of the Rockwood, Mo., schools, near St. Louis, has been grappling with the technical-support issue in trying to manage a rapid influx of technology into the 20,000-student district. In only 10 months after voters approved a bond request in April 1996, the district added advanced networks and more than 2,000 multimedia computers to its previous stock of 4,000.

In private industry, Glaser says, companies provide a support person for every 35 to 150 personal computers, depending on the company. The Rockwood district currently has 10 support people of various skill levels—one for every 600 computers.

“Obviously, in the last year, we’ve been asking ourselves what innovative ways we can increase our support,” Glaser says.

The district’s strategies have included adding a work-order tracking system on the districtwide network and installing a management system that enables technicians to attend to problems on network servers and hubs without having to leave their offices.

School administrators in a number of states are turning to students for technical help. In Issaquah, Wash., a suburb of Seattle, for example, more than 300 high school students are organized into teams to maintain networks and run student Internet services throughout the district’s schools.

A few students visit the district’s elementary schools and some middle schools every week, installing wiring, loading software, training teachers and students, managing Internet accounts, and performing other maintenance and repair functions. The students get course credit, and their skills lead to well-paying summer jobs and sometimes to permanent employment.

Michael Bookey, a parent who helped build the Issaquah project from a networking activity for eight students in 1989, says it exemplifies the kind of creative solutions that school leaders will need to survive the technological changes ahead.

“Schools must operate more like new-age companies than industrial-age factories,” he says.

But Tucson’s Rodriguez warns against depending too much on students for technical support: “It’s realistic if you assume you’re going to have a structured organization behind it. The idea that a district can only run its schools with kids is far-fetched and dangerous.”

Another key administrative responsibility is to assess the results of a district’s technology program. Few, if any, school systems have figured out how to measure the effect of technology on student learning. But a promising effort is under way in Montgomery County, Md., an affluent suburb of Washington.

The 125,500-student district is in the middle of an ambitious plan to connect classrooms, media centers, and offices electronically so students and staff can tap information and communicate within the district through an intranet, and globally via

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One argument that people make is that computers and up-to-date technology can be used for mundane administrative tasks such as taking attendance or marking grades, which would then free up teachers and administrators to focus on the most important part of education, which is teaching and counseling children. How important is this particular use of up-to-date technology?

The Broward County, Fla., schools are betting a lot of money on their new data infrastructure, which lets principals or teachers delve into district records for their students’ test scores, attendance patterns, or even health information, and sort it to create profiles of individual schools or classes. A three-school pilot test is being expanded to 20 schools this year.

“All of a sudden, we have data in ways we never had it before,” Varela-Russo says.

But she cautions that educators need to be trained to use this deluge of data effectively. “You need to know how to analyze data and translate that into something different to improve mastery of learning in the classroom,” she says.

In its leadership programs for principals and assistant principals, Broward has added training in how to crunch data, interpret the results, and make appropriate changes in their schools, she says. And district administrators routinely give research briefs to principals to explain to them the meaning of data reports.

“I will tell you there is a tremendous difference in what principals understand now and what they used to,” Valera-Russo says.

Districts such as Broward that blur the distinction between administrative and instructional uses of technology may have a leg up on the goal of achieving meaningful school change, according to a growing cadre of experts. Not only will the districts benefit from a richer environment of data, consultant Rhodes says, they also can develop stronger connections among their personnel.

“You have technology now to connect people in different ways and align them to a purpose and support them in a way that’s sustainable,” he says.

Such connections include everything from telephones and e-mail, which help teachers, administrators, and employees chat more conveniently, to central databases that store the accumulated expertise of school staff—as in Broward, where computers at every school can access current academic standards, tips on teaching strategies, and recommended technologies.

New technological capabilities will require administrators to adopt new ways of managing, says Tice, the Strafford, Mo., superintendent.

He cites the biblical admonition against sewing a piece of new cloth onto an old garment. “In education, we continue to take something new and patch it into our old way of doing things,” Tice says.

“When we get this new power of technology, we generally try to do things better,” he adds. “The real challenge is we need to do better things.”

**Managing With Technology**

What is the No. 1 or No. 2 activity that teachers in your school/district use computers for?

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**Administrative Uses**

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<thead>
<tr>
<th>Percentage</th>
<th>Customer Service</th>
<th>Administration</th>
<th>Classroom Instruction</th>
<th>Management of Classroom Grading, Reporting, and Assessment</th>
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**Record Keeping in Schools**

Percentage of schools using advanced telecommunications for record keeping in 1996, by grade level and school size.

---

Managing Technology

<table>
<thead>
<tr>
<th>State</th>
<th>% of districts with WAN</th>
<th>% of superintendents who use computers</th>
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**Percentage of districts with WAN:** A WAN, or wide-area network, is a computer network in which widely dispersed computers, such as those located in several buildings across a city, are connected. Administrators can use a WAN to transmit information, such as student work, bus schedules, or electronic records, to schools. (See note on MDR’s methodology, Page 20.)

**Percentage of district superintendents who use computers:** In a survey of school districts, Market Data Retrieval asked the superintendent, or someone who worked for him or her, whether he or she used a computer every day.

**Sources and notes:**

The data for this table are drawn from research by the firm Market Data Retrieval. Percentage of districts with WAN: A WAN, or wide-area network, is a computer network in which widely dispersed computers, such as those located in several buildings across a city, are connected. Administrators can use a WAN to transmit information, such as student work, bus schedules, or electronic records, to schools. (See note on MDR’s methodology, Page 20.)

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- how technology can be used to support professional development;
- the strengths and weaknesses of teachers networks and why many are interested in creating them;
- how professional development dollars are spent;
- what practicing teachers have to say about their opportunities to learn and grow in their work.

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- teacher training and professional development;
- school-public partnerships;
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Partnering With THE PUBLIC

By Mary Ann Zehr

Much has been made of technology’s ability to open schools up to the world via the Internet and satellite. But technology is playing an equally powerful role in opening schools up to their local communities.

In many districts, parents can write teachers a note through electronic mail or call them directly on a classroom phone. Teachers can post students’ work on Web pages. Schools can provide students with take-home laptops.

One result of such developments, some experts say, is that the public’s involvement in schools is growing.

“Schools have been isolated for a long time, and they can’t be anymore,” says Melanie Goldman, the manager of the National School Network, a research project initially funded by the National Science Foundation. “We’re seeing a resurgence in interest from the community. Technology has unfrozen the structure that has been in place for a long time.”

The changing relationship between schools and the community is even making some educators rethink what they mean by “school.”

“The more we expand the communication and information services, the more that everyone is getting involved in education,” says Frank B. Withrow, the director of educational programming at the Foshay Learning Center, for example, a K-12 public school in Los Angeles, has set up eight satellite learning centers in low-income apartment complexes across the city. Without leaving their buildings, students can get help with homework, learn about technology, and participate in enrichment activities.

“School is anywhere the equipment is” says Cynthia Amos, the program administrator for Foshay’s satellite project. “We’re trying to show the kids that you can learn anywhere.”

As technology increases people’s access to schools, their interest level increases as well, educators are finding.

Some parents who otherwise might never have volunteered in a school are looking up classroom computers to the Internet. Many businesses are donating equipment to schools and trying to capitalize on the new market for educational products.

“The more we expand the communication and information services, the more that everyone is getting involved in education,” says Frank B. Withrow, the director of educational programming at the NASA Classroom for the Future project at Wheeling University in West Virginia. “One of the challenges that the schools have is how do they take advantage of that?”

Better communication between teachers and parents is one goal for a state-funded program in Indiana called the Buddy System. In this program, computers and modems are placed in the homes of 7,000 elementary school students, usually 4th and 5th graders, for a one- or two-year period. Schools submit proposals to participate, and are selected in part on their record of family involvement.

One evaluation of the Buddy System conducted by an independent consulting firm showed that it “established and strengthened home-school connections.”

Alan T. Hill, the president of the nonprofit group that runs the Buddy System, says parents have been so enthusiastic about it that “we have to fight them off” when they have an opportunity each year to present to the state legislature what they’re doing with computers. “We only have room for 150 people [inside the state capitol’s rotunda],” Hill says. “We have to give schools quotas.”

One attractive feature of the Buddy System is that it allows parents to communicate with teachers using e-mail. But this isn’t necessarily why the program has been so successful. Indeed, two parents in the program who were interviewed recently say they rarely use e-mail.

Hill says there are other “hooks” that get parents involved as well.

When they receive a computer, they often feel like they’ve gotten “something very tangible and useful from their local school system,” Hill says. “As a result, they become more involved in working with the teacher. They have to go to the school to pick up the equipment. There’s a minimum of training required. Many of them have never been in the schools.

In many Buddy System schools, Hill says, parents run computer training programs for families.

A more basic form of technology—the telephone—has a longer track record in improving communication between school personnel and parents. Teachers at Canton Middle School in Baltimore, for example, have had phones in their classrooms for the past four years.

“If something is going wrong, they pick the phone right up and say, ‘We’re having a crisis,’” says Carolyn Fowler, the mother of a Canton 8th grader. “Not only do they call the parent to say, ‘Your child did this.’ They also call to say, ‘Your child had a good day.’ It makes the parent feel really good.”

About twice a week, Fowler calls the school’s homework hotline, on which teachers record a message each day for parents and students to access in the evening. Before her child attended Canton, Fowler says, it was easy for him to say, “There isn’t any homework.”

Canton also uses the voice mail system to send an automatic message to parents at 6:30 a.m. if their child was absent from or arrived tardy at school the day before. “I notice an increase in promptness,” says Nilah Briscoe, the school’s technology manager. “Mother and Dad are saying, ‘Why were you late?’ It’s like an alarm to get them up in the morning and get the child to school on time. It works.”

Education Week • November 10, 1997
Web pages, meanwhile, are being used less for direct home-school communication than as a way to keep parents generally informed about school or class activities. “I see a lot of publishing of the kids’ work, which is going to involve parents. I’ve seen very little parent-teacher communication going on,” says Stephen Collins, the project manager for Web66, a University of Minnesota-based effort to track schools’ use of Web sites.

Kim Cobb, a parent of twins attending South Elementary School in Hingham, Mass., says her children’s school Web site “keeps me on top of what’s going on without my having to be there. It’s great for working parents.”

But she adds, “It’s not a substitute for being in touch with the teachers themselves.” Barbara Davis, the mother of a 6th grader at South School in Holbrook, Mass., volunteered to be the coordinator for a school Web site that she just helped launch. “We have the lunch menu up there and school calendar, and people liked that because often those things don’t go home,” she says.

Within a year, she expects, the Web site will have a separate page for each class, giving teachers the option of posting information about homework for their classes.

Typically, Davis says, “Your kid comes home from school and you say to your child, ‘What did you do in school today?’ Usually he says, ‘Oh, nothing.’ ” School Web sites give parents an alternative, she says.

As it becomes increasingly important for students and parents to have a computer at home, concerns are being raised about those families who can’t afford one. “You can’t get a good job without some computer skills,” says Ralph Bunday, a physics teacher at Montgomery Blair High School in Silver Spring, Md. He is worried that low-income students aren’t getting the access to computers they need to compete in the job market. Students with a computer in their home have more time to become comfortable with technology, adds Susan Ragan, a computer science teacher and colleague of Bunday’s. “You get to sit there for hours at a time rather than having to jump up after 45 minutes and go to your next class,”

Bart Decrem, the executive director of Plugged In, a program that offers computer access to students in a low-income neighborhood near Silicon Valley in California, agrees.

Unless students have access to computers, technology is merely “something they read about in the newspaper,” Decrem says. “It doesn’t become part of their daily world.”

The most recent national data about the distribution of technology in the homes of school-age children comes from last year. It shows that 32 percent of children from ages 9 to 17 had a computer in their home. Almost 36 percent of white children had one, compared with 13 percent of black children and 12 percent of Hispanic children.

Access to computers at home can vary greatly even among students in a single school. “We have $5 million houses along the lake and we have 28 percent of students on free or assisted lunch,” says Frank Gagnon, the department chairman of media and technology services for Evanston Township High School in Evanston, Ill. “Some go home to their own computer in their own bedroom. Others go home and have to go to the library to use the computer.”

To help address the equity issue, the school opens its media and computer centers up to students before and after school. Some are receiving academic or community-service credit for setting up computer centers—with donated equipment—in low-income apartments where some of the school’s students live.

Concerns about equity are behind some schools’ efforts to lease or loan computers to students for their home use. But many experts agree that these programs are too expensive for most schools to afford without an outside source of funding.

Even Indiana’s Buddy System program, which also uses the public’s support, had its state funding cut in half—from $6 million to $3 million—for the current biennium.

In South Carolina, residents and businesses in the Beaufort County school district have made it possible for selected middle school students to take home laptop computers by setting up a foundation that raised money to subsidize the cost. Parents all pay something each month to lease the computers for their children; the amount depends on their income level.

“We would not have these computers except for the fact that we have local support by people in our county,” says Denise Smith, the principal of Robert Smalls Middle School, where 55 6th graders took home laptops last year. “These are business persons who are willing to step out and say, ‘Our children deserve this opportunity’ and are willing to commit themselves to make this available to all our children.”

She adds that the student laptop program “is catching on almost like wildfire.” Requests to participate at her school have increased five-fold from the previous year.

But already this year, the foundation is having to increase the amount that parents must pay to rent a laptop. The basic rental fee has increased from $35 to $80 a month. Parents of students receiving free lunches pay $15 a month, a $5 increase from last year.

If a school does hand out equipment, it also must make sure that families know what to do with it, says Peter B. Miller, the network director for the Community Technology Centers’ Network, a membership organization for community technology centers.

“Any program that is based on the distribution of

Continued on Page 38
“There’s a growing interest in businesses connecting with schoolchildren for great reasons and some not-so-great reasons. Children constitute a huge market.”

Anne Bryant, Executive Director, National School Boards Association

Continued from Page 37

hardware and software and doesn’t give sufficient attention to staff training and support as well as training in the home is going to fall flat,” Miller says.

One segment of the public that has welcomed schools’ increased use of technology is the business community.

“There’s a growing interest in businesses connecting with schoolchildren for great reasons and some not-so-great reasons,” says Anne Bryant, the executive director of the Alexandria, Va.-based National School Boards Association. “Children constitute a huge market.”

Many businesses, to be sure, are motivated by some not-so-great reasons. Children constitute a huge market.”

School technology became especially attractive to businesses when the emphasis shifted from “administrative processes” to “learning processes,” says Rick Normington, an area vice president of the education market group for Pacific Bell. “We’re shifting into an environment where we’re trying to bring more information into the classroom. That’s what’s causing the market to explode.”

Pacific Bell has agreed to commit $100 million between 1994 and the year 2000 to a technology program called Education First that provides free ISDN lines to California schools and libraries, an education Web site, four roving technology trainers, technology workshops, and other services.

Normington says some school leaders were suspicious of the program at first.

“We spent so much time publicizing what we were doing, we created some fear on the part of educators that our motives weren’t real;” he says. “We stopped publicizing for a while and instead made sure that the schools understood we would be around for the long term.

“If a business is only interested in a marketplace or publicity, the school’s going to recognize that,” Normington adds. “They’re going to be reluctant to accept help from someone who’s going to disappear once the reporters are gone.”

NetDay is perhaps the best-known example of how technology can boost the public’s involvement in schools.

The project was started in 1996 by Michael Kaufman, a senior director of digital learning for PBS, and John Gage, a chief scientist for Sun Microsystems, as a one-day event to wire schools in California for access to the Internet. At the request of the White House and the U.S. Department of Education, they expanded the project nationwide.

As of this fall, more than 250,000 volunteers had helped wire 50,000 classrooms across the United States.

Some observers say those figures don’t tell the whole story, noting that if classrooms don’t have computers, or teachers don’t have training, wiring doesn’t make much of a difference.

But no one can deny that the effort has touched a chord.

“It’s seeing people from all walks of life wanting to wire the classrooms in the school in their neighborhood. . . . It almost becomes a competitive thing,” says Ann Murphy, a NetDay national organizer.

“People kept writing to us and saying, ‘I’ll organize Texas. I’ll organize Oklahoma. So you have a unique NetDay in every state.’

Participants in Massachusetts have included “a lot of young people in their 20s and 30s who have been exposed to technology in the workplace,” says Steve Miller, the head of NetDay in Massachusetts and the executive director of Mass Networks Education Partnership. “They like it, know it’s important, and want to share it.”

NetDay is also helping wire schools in disadvantaged areas that might not otherwise be able to afford technology, says Suzanna Gomez, the assistant director of civil and human rights for the AFT-CIO. She has been coordinating union participation in NetDay in federally designated empowerment zones.

“We consider this civil rights,” Gomez says, noting that 67 percent of the new entries to the workforce between 1994 and 2000 are expected to be women and minorities and that 60 percent of the jobs by the year 2000 will require technical skills.

Helping to wire schools “is not only the moral thing to do, but the right thing to do,” Gomez says. “The program has intangible benefits as well, Murphy says.

“NetDay is bringing people back into the classroom to see what kind of condition schools are in,” she says.

“We found that once people get connected with the school, they stick around and don’t leave.”
Availability
From what you know about the public schools in your community, do you think there is too much, too little, or the right amount of the following:

- Access to adequate computers and up-to-date technology
- Teachers who are familiar with use of computers and up-to-date technology
- Students who are familiar with use of computers and up-to-date technology

![Graphs showing availability data](image)

Note: 1,012 voters polled by telephone.

Home-School Connection
What parents with on-line children want from home-school access.

![Graphs showing home-school connection data](image)


Workforce Readiness
What employers and graduating seniors believe about students’ preparedness for the workplace.

![Graphs showing workforce readiness data](image)

Note: 303 human resource executives and 969 high school seniors polled by telephone.

High-Tech Advantage
When it comes to the items below, do you think the school that is well-equipped with computers has a very major advantage, a fairly major advantage, a minor advantage, or no advantage over the school that is poorly equipped?

![Graphs showing high-tech advantage data](image)

Note: 1,012 voters polled by telephone.
School technology enjoys support from across the political spectrum, but states pursue a range of strategies to increase it. The bottom line remains, though, that there’s a disturbing lack of data to help guide decisions.

By Kerry White

School technology has become the educational initiative du jour for lawmakers across the nation and of every political stripe. They might argue vehemently about school choice and national standards, but they’re in almost total agreement when it comes to the need for computers and other kinds of technology in the classroom.

“Students unable to use the tools of this information age will be forever at a disadvantage,” Republican Gov. Pete Wilson warned the California legislature before unveiling a $1 billion school technology initiative earlier this year.

“Education technology is an absolute essential,” Nevada Gov. Bob Miller, a Democrat, declared before introducing his $44 million school technology bill this summer.

These sentiments are echoed in Washington, where President Clinton, Vice President Al Gore, and Education Secretary Richard W. Riley tout the value of school technology at every opportunity.

As an education issue, “technology is unusual because there’s such a broad base of support for it among lawmakers and parents, regardless of political party,” says John Barth, an education policy analyst at the Washington-based National Governors’ Association.

“There’s been a strong and positive sea change both in Washington and state capitals on school technology and the potential for it to drive educational improvement,” adds David Byer, the vice president for government affairs for the Washington-based Software Publishers Association.

“There’s an understanding that technology can make a difference in schools and will ultimately define our ability to compete.”

Legislators have come to that conclusion despite the lack of hard data indicating that technology does, in fact, improve academic achievement. Many states have little information on how much technology is in their schools, much less whether it is being used effectively.

So far, that hasn’t hindered policymakers’ support. Schools spent an estimated $4.3 billion on technology last school year and are projected to spend $5.2 billion this school year, according to a survey by the research firm Quality Education Data.

“It’s too great a risk not to have computers in schools,” says Michael Sentence, an education advisor to former Massachusetts Gov. William F. Weld and now acting Gov. Paul Cellucci. Data or no data, “we know that they’re an important tool. And voters are convinced that computers are an absolute necessity for schools.”

But Nebraska Lt. Gov. Kim Robak, a Democrat, says support for technology would increase, and the money would be better spent, if states had better data.

“We need information to show what works and what doesn’t,” Robak says. “If we had empirical data, policymakers would be more willing to fund [technology], and voters would be much more willing to pay.”

Despite the general consensus that school technology is important, states are taking widely differing approaches to increasing it. Many of them, for example, are emphasizing multimedia computers; others are putting their money into Internet access or distance learning.

States are also at various stages of the process. Some have been talking about technology for years, while others are just starting to address it. “States are remarkably distinct from one another,” observes Jeanne Hayes, the president of QED. “There are 51 different domains.”

But she and others say there are clearly some vanguards, and experts especially laud states that have tied technology to broad education reform efforts, rather than implementing technology simply for the sake of computer literacy.

Experts also praise states that make teacher training a top priority in state and local technology planning. Teacher training, they say is essential to ensure that the millions of dollars invested in hardware and software are put to good use.

“The issue of having teachers adequately trained and prepared is key,” says Barbara Stein, a senior policy analyst for the Center for Education Technology in Washington. “Policymakers are showing a greater understanding about the need for professional development” and are beginning to address it in their state budgets.

One state that often receives praise for its school-technology efforts is West Virginia. Under Democratic Gov. Gaston Caperton, the state established a $70 million, 10-year program to improve students’ reading, writing, and math skills. The legislation appropriated about $7 million each year—most of which comes from the state lottery—to outfit classrooms with technology, and about 30 percent of the funds have been earmarked for professional development programs.

By next month, the state expects to be the first in the nation to have every school wired for a local-area network and the Internet. West Virginia also has roughly four computers per classroom in all its elementary schools, and all the teachers in those schools have received training in technology.

Current Gov. Cecil H. Underwood, a Republican, has continued that commitment to school technology since he took office last year. “Everyone in West Virginia—the governor, the chief state school officer, and the legislature—is talking out of the same side of their mouth,” says Frank B. Withrow, the director of education for NASA’s Classroom of the Future project at Wheeling University in West Virginia.

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Residents supported the state's emphasis on technology from the beginning, adds Robert J. Dilger, a professor of political science at West Virginia University in Morgantown.

School technology "has always been a politically saleable idea here....Everybody bought it," Dilger says. After several years of bipartisan support, he adds, "school computers are more than a political gimmick."

One key to West Virginia's success was the state's decision to buy all of the districts' hardware and software in bulk and provide the lion's share of teacher training and technical support, state Superintendent Henry R. Marockie says.

Many districts—especially small ones—lack the business and technical expertise to undertake such efforts on their own, he notes. "Everybody got on board as fast as they could because the program was such a winner," he adds.

West Virginia's achievements notwithstanding, some experts argue that a top-down approach does not work for every state because it robs schools of local control. Programs that grow from the grassroots level, they say, get more people involved and are, therefore, more likely to be sustained over time.

"The centralized model is not always the best one," says Cheryl L. Lemke, the vice president of education technology for the Milken Exchange on Education Technology and a former associate state superintendent for technology in Illinois. "Change happens when local school officials, educators, and parents become part of the program."

Experts say Kentucky's school technology program has been successful for that very reason.

The state's plan, a component of its landmark Kentucky Education Reform Act of 1990, calls for a telephone in every classroom and a computer for every six students and every teacher in the state.

The program is tied to the state's educational goals, and local districts and individual schools decide how best to use technology to meet them, notes Don Coffman, the Kentucky education department's associate commissioner for school technology.

Kentucky requires each district to have a long-range technology plan, and districts get money from the state on a sliding scale according to local wealth and as long as they are working toward fulfilling its plan. Districts are allowed to make their own software and hardware purchases, but have the option of taking advantage of manufacturers' volume discounts by purchasing at the state level.

The program has worked, Coffman says, because of its bottom-up approach. "This is a local effort," he says, "where schools and teachers are integral" to the planning and purchasing process.

In high doses, however, local control can be a barrier to statewide school technology initiatives, some policymakers say.

In Nebraska, Lt. Gov. Robak complains that a "lack of coordination" between state and local government agencies, colleges and universities, businesses, and schools has hampered technology progress.

"Without coordination, we can't build a base," she says. "We have no mechanism to pull it all together. We can't have an analog system in one county and a digital in another. Local control can't go all the way down to the infrastructure."

Balancing local and state authority is only one of the challenges facing policymakers in the area of school technology. Another is the perennial issue of funding.

Some legislators, as in Alabama and Kansas, have been reluctant to invest in technology because they say it would take money away from other educational needs that are more pressing. And in many states, technology advocates have had difficulty persuading lawmakers to sustain state spending for more than a year at a time.

Don Coffman of Kentucky, for example, has been unable to secure double funding for the program for fiscal 1998 to 1999.

"School technology requires a huge amount of investment," and the enormous costs allow some lawmakers to believe that it's a one-time-only obligation, says Christopher Dede, a professor of information technology and education at George Mason University in Fairfax, Va.

But, he says, the ongoing expenses of school technology programs—such as hardware upgrades, teacher training, and software—are equally important.

Technology funding also raises the thorny problem of equity. Almost all states report that while a few of their districts have made great leaps in school technology, others have barely gotten off the ground.

Legislatures have struggled with ways to reduce the disparities, with varying degrees of success. Many have chosen to direct federal grants to districts with the greatest needs.

Perhaps the biggest challenge for legislators in the area of technology is planning. Experts warn that lawmakers can waste a lot of money on equipment if they approach technology in a disjointed way.

"Before states act, they need to think strategically and for the long-term," says Barth of the National Governors' Association. "Lawmakers need to ask themselves, 'How are we going to use computers to meet educational goals? How are we going to promote the most efficient practices at the local level? How are we going to train teachers to use them?'"

"A lot of systems are approaching technology in a piecemeal fashion," where plans and purchases are made over several years or in an unconsolidated manner, adds Felix Perez, a policy analyst at the National Education Association.

The best initiatives, he observes, are ones that "give districts flexibility to make a package that's best for them—where there is control at the local level, but support and structure at the state and federal levels."

Dede explains that "federal, state, and local technology programs need to be interrelated, so that rather than ships that pass in the night, they're two sides of the same coin."

President Clinton laid out his technology plan in 1996, setting "four pillars" for technology in schools: modern computer hardware, connectivity, teacher preparation, and high-quality educational software and on-line resources.

Federal technology funds, meanwhile, stream into schools from a bevy of sources, including the departments of education, commerce, and agriculture; the National Science Foundation, and the National Endowment for the Humanities. (See box on next page.)

The most prominent federal technology program is the Technology Literacy Challenge Fund, a Department of Education program offering grants to every state.

The Clinton administration has asked Congress to double funding for the program for fiscal 1998 to $425 million.

"We need information to show what works and what doesn't."
As an education issue, “technology is unusual because there’s such a broad base of support for it among lawmakers and parents, regardless of political party.”

John Barth, Education Policy Analyst, National Governors’ Association

Sources of Federal Money

The following are among the federal agencies and programs that provide resources for school technology:

- Department of Education: (www.ed.gov/Technology)
- National Science Foundation: (www.nsf.gov)
- Department of Commerce: (www.ntia.doc.gov)
- Department of Agriculture: (www.usda.gov)
- Office of the Secretary: (www.oﬃceofthesecretary.ed.gov)
- USPS: (www.usps.gov)
- Department of Labor: (www.dol.gov)
- Corporation for National Service: (www.corporationforservice.gov)
- Telecommunications Industry Development Fund: (www.telefund.org)
- Federal Communications Commission: (www.fcc.gov)
- National Telecommunications and Information Administration: (www.ntia.doc.gov)
- National Telecommunications and Information Administration, e-rate: (www.e-rate.com)
- Department of Defense: (www.defense.gov)
- Department of Justice: (www.justice.gov)
- Department of Housing and Urban Development: (www.hud.gov)
- Department of Health and Human Services: (www.hhs.gov)
- Department of Transportation: (www.dot.gov)
- Department of Energy: (www.energy.gov)
- Environmental Protection Agency: (www.epa.gov)
- Energy Star Program: (www.energystar.gov)
- American Recovery and Reinvestment Act: (www.recovery.gov)
- Department of Education: (www.ed.gov)
- National Science Foundation: (www.nsf.gov)
- Department of Commerce: (www.ntia.doc.gov)
- Department of Agriculture: (www.usda.gov)
- Department of Housing and Urban Development: (www.hud.gov)
- Department of Health and Human Services: (www.hhs.gov)
- Department of Transportation: (www.dot.gov)
- Department of Energy: (www.energy.gov)
- Environmental Protection Agency: (www.epa.gov)
- Energy Star Program: (www.energystar.gov)
- American Recovery and Reinvestment Act: (www.recovery.gov)

The following are among the federal agencies and programs that provide resources for school technology:

- School to Work Opportunities Act: Provides grants to states and communities for programs integrating academic and vocational learning with work-based learning. (Program is administered jointly by the departments of Education and Labor.)
- Technology Innovation Challenge Grants: Provides grants to stimulate the development of advanced telecommunications equipment for educational and cultural purposes.
- Teacher Enhancement: Offers a number of grant programs intended to help teachers and administrators use technology to promote math, science, and technology. (www.ed.gov)
- National Center for Rural Telecommunications: (www.ncrt.org)
- National Center for Rural Technology: (www.ncrt.org)
- National Telecommunications and Information Administration: (www.ntia.doc.gov)
- National Telecommunications and Information Administration, e-rate: (www.e-rate.com)
- Department of Defense: (www.defense.gov)
- Department of Justice: (www.justice.gov)
- Department of Housing and Urban Development: (www.hud.gov)
- Department of Health and Human Services: (www.hhs.gov)
- Department of Transportation: (www.dot.gov)
- Department of Energy: (www.energy.gov)
- Environmental Protection Agency: (www.epa.gov)
- Energy Star Program: (www.energystar.gov)
- American Recovery and Reinvestment Act: (www.recovery.gov)

Financial Support

Would you be willing to pay $1.00 more in federal taxes if the additional money were used only to equip public schools with computers and up-to-date technology?

% of Voters

Raising cigarette tax
Raising corporate income tax
Raising state sales tax
Special sales tax on computers and technology
Increasing property tax/levy bond

Who Should Pay?

Voters rank support for potential revenue sources for equipping schools with up-to-date technology.

- Raising cigarette tax: 72
- Raising corporate income tax: 61
- Raising state sales tax: 34
- Special sales tax on computers and technology: 38
- Increasing property tax/levy bond: 56

Note: 1,012 voters polled by telephone.

Sources of Federal Money

The following are among the federal agencies and programs that provide resources for school technology:

- Technology Innovation Challenge Grants: Provides seed money for technology-based teaching strategies in areas of high poverty.
- Technology Literacy Challenge Fund: Provides seed money for technology to states, which then distribute the funds to districts.
- Star Schools Program: Supports distance learning for underresourced schools, also provides support for teacher training and other activities produced via satellite.
- Individuals With Disabilities Education Act: Provides funds for hardware and software for students with special needs.
- Goals 2000: Educate America Act: Provides planning grants to each state that can be used to integrate technology into overall state education improvement plans.
- Title I Education for the Disadvantaged: Funds can be used for software and hardware, primarily for basic skills instruction.
- Title II: Eisenhower Professional Development State Assistance Program: Intended for sustained, high-quality professional development for teachers and other school personnel.
- Title III: Eisenhower Teacher Enhancement: Offers a number of grant programs intended to help teachers and administrators use technology to promote math, science, and technology.
- Title I: Education for the Disadvantaged: Provides grants to rural schools, libraries, and other educational institutions for advanced telecommunications systems.
- National Endowment for the Humanities: (www.neh.gov)
- National Endowment for the Humanities: (www.neh.gov)
- National Endowment for the Arts: (www.arts.gov)
- National Science Foundation: (www.nsf.gov)
- Corporation for National Service: (www.corporationforservice.gov)
- Telecommunications Industry Development Fund: (www.telefund.org)
- Federal Communications Commission: (www.fcc.gov)
- National Telecommunications and Information Administration: (www.ntia.doc.gov)
- Department of Commerce: (www.ntia.doc.gov)
- Department of Agriculture: (www.usda.gov)
- Department of Labor: (www.dol.gov)
- Department of Justice: (www.justice.gov)
- Department of Housing and Urban Development: (www.hud.gov)
- Department of Health and Human Services: (www.hhs.gov)
- Department of Transportation: (www.dot.gov)
- Department of Energy: (www.energy.gov)
- Environmental Protection Agency: (www.epa.gov)
- Energy Star Program: (www.energystar.gov)
- American Recovery and Reinvestment Act: (www.recovery.gov)

Continued from Page 41

Another notable federal technology initiative was announced in May, after the Federal Communications Commission decided to provide virtually every school and public library a specially discounted “education rate,” or E-rate, on telecommunications services, internal connections, and Internet access.

The long-awaited discounts, available beginning Jan. 1, will range from 20 percent to 90 percent depending on a school’s price for a penny.

The discounts could amount to tremendous savings for schools, “especially poor schools,” explains John T. MacDonald, the director of state leadership for the Council of Chief State School Officers in Washington.

But, he warns, the savings depend entirely “on how wisely the discounts are used. The [school system’s] technology plan is so important.”

Companies that provide the discounts will be reimbursed through a fund—the Universal Service Fund—paid into by all telecommunications companies.

Still, experts say, the federal endorsement resonates. “Policymakers are interested and impacted by the federal government’s leadership on this issue,” Lemke of the Milken Exchange says. “And dollars follow vision.”

School technology “has exploded because of people like the president showing they have a very deep interest in this,” adds Perez, the NRA analyst. “Critical mass has been reached. Schools need to capitalize on this momentum.”

Education Week - November 10, 1997
# The Policy Arena

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<thead>
<tr>
<th>State</th>
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<th>Percentage of high-tech schools</th>
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**Source and notes:**

- State has survey to collect technology data: States with an X have a survey to collect data and have reported the results to the American Institute for Research/Pelavin Associates. States with a blank either do not have a survey or have not responded to AIP's request for information.
- Percentage of high-tech schools: The data are drawn from research by the firm Market Data Retrieval. MDR defines high-tech schools as schools with a computer network system, Internet access, and better-than-average availability of computers and CD-ROMs. (See note on MDR's methodology, Page 20.)

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State-by-State Profiles

A Guide to Reading

The State Profiles

State Education Agency Web Site: All state departments of education maintain home pages on the Internet.

State Education Agency Technology Contact:

In most cases, the contact person is in charge of managing technology advances within a state, organizing and conducting grant competitions related to technology, and assisting with the formulation and revision of technology policy. The person listed serves in at least one of these capacities.

Technology Literacy Challenge Fund: The figures listed show how much the state received from this federal source in fiscal 1997 and is projected to receive in fiscal 1998. The fund provides formula grants to state education agencies. The grants help the agencies implement statewide technology plans through competitive funding to districts using new technologies to improve schools.

U.S. Department of Commerce, TIAP: The figure listed shows how much the state received from the Telecommunications and Information Infrastructure Assistance Program in 1995 and 1996. This is a competitive program that has allowed an important role in demonstrating practical applications of new technology.

1997 Technology Innovation Grant Program: The figures listed show how much the state received from the 1997 Technology Innovation Challenge Grant Program. The competitive U.S. Department of Education program strives to improve and expand new applications of technology to strengthen school reform efforts, improve student achievement, and provide ongoing professional development for school personnel.


Student-Multimedia Computer Ratio: The source is a survey completed in June by Market Data Retrieval. A multimedia computer has a sound card and a CD-ROM drive, components that enable it to use cutting-edge educational software. (See note on MDR’s methodology, Page 20.) Some of the state narratives also include state-provided data that may conflict with MDR’s figures.


Technology-Trained Teachers: The figure shows the percentage of the state’s teachers who had at least nine hours of educational technology training in 1996. The tabulation comes from the National Data Resource Center. Data are collected as part of the U.S. Department of Education’s “1995-96 Schools and Staffing Survey.”

The following are descriptions of the charts accompanying the state narratives:

Computer Availability: The data are drawn from the “National Assessment of Educational Progress 1996 Mathematics State Reports” based on 4th and 8th grade public school teachers’ reports on the availability of computers. All NAEP data are rendered in student percentages. In Alabama’s chart, for example, 10 percent of 4th grade and 31 percent of 8th grade math students had teachers who reported having no access to computers. Not all states participate in NAEP, and participating states often test only one grade level. Percentages may not total 100 because of rounding.

Computer Use: The data are drawn from the “National Assessment of Educational Progress 1996 Mathematics State Reports.” NAEP data are rendered in student percentages. In Alabama’s chart, for example, 58 percent of 8th grade math students report never or hardly ever using a computer in mathematics. For some states, data are for 4th grade students because no 8th grade data were available. Percentages may not total 100 because of rounding.

Alabama

- State Education Agency Web Site: www.alsde.edu/
- State Education Agency Technology Contact: Lisa A. Woodard (334) 242-9594
- Technology Literacy Challenge Fund: FY 1997: $5.5 million
- Technology Innovation Challenge Grant Program: FY 1997: $6.8 million
- Student-Multimedia Computer Ratio: 29:1
- Number of Teachers: 43,843
- Technology-Trained Teachers: 12 percent

As has happened with other K-12 initiatives in Alabama, politics have thrown the state’s school technology plan into limbo.

In February, the Alabama board of education approved an ambitious vision for infusing technology into elementary and secondary education. But in June, the legislature balked at the price tag, leaving the plan with an uncertain future.

The need is great in a poor state like Alabama for nearly every type of school improvement, including technology. Computers are hard to come by at many schools, and much of the equipment is outdated. Most teachers lack a computer workstation, not to mention Internet access for themselves or their students. There are few electronic connections between schools and postsecondary institutions, and most school records are transferred by hand.

Supporters of the proposed technology plan, who included Republican Gov. Fob James Jr., were counting on the legislature to address the shortcomings by approving a $125 million bond issue. But in June, the legislature balked at the price tag, leaving the plan with an uncertain future.

The new proposal would buy a skeleton of network connections leading up to the schoolhouse door. But local districts would have to go it alone inside the schools themselves.

“Some of the more financially destitute systems will have a difficult time availing themselves of this technology,” acknowledges Edward R. Richardson, the state schools chief and a backer of the original technology bond.

The loss of the larger bond issue also could jeopardize both the speed with which the state can show gains in student performance and its compliance with a state court’s order to improve the condition of impoverished schools, he adds.

“If we’re trying to compress the time in which we show marked improvement in student achievement,” Richardson says, “we’ve now lost one of the tools that would have been invaluable to our teachers.”

Meanwhile, state officials emphasize that other efforts, using federal and local monies or volunteer efforts, are still proceeding.

Alabama is using the $6 million it received from the federal Goals 2000: Educate America Act for educational technology.

And in fiscal 1997, Alabama received $3.5 million from the federal Technology Literacy Challenge Fund. That money went for networking schools as well as for the purchase of computers. Of the state’s 127 districts, 100 applied for grants, receiving between $5,600 and $897,500 each.

Alabama officials also hope that the much-anticipated federal “E-rate” telecommunications discounts will supplement the state’s $35 million bond issue, says Lisa A. Woodard, an education specialist in the state’s office of technology initiatives.

Although Alabama did not organize a statewide NetDay, many school systems held one or several of the volunteer events. Other districts did not take part, believing that they should not proceed with wiring for Internet access without first being certain of the state’s contribution.

Indeed, some schools that wired themselves are now waiting for the state to hook them up to a network.

Alabama continued on Page 46
Alabama continued from Page 45

work, Woodard says.

The infusion of education technology statewide “may not happen as fast as we hoped,” she says, “but we want to fulfill this commitment.”

The difficulties in getting the technology plan off the ground in Alabama lend weight to a worry voiced by the peer panel that reviewed the state’s application for the TLCF grant. They were impressed with the state’s goals, but said: “The major concern for the panel is the fear that this visionary plan will merely remain a dream.”

—MILLICENT LAWTON

A L A S K A

• State Education Agency Web Site: www.educ.state.ak.us/
• State Education Agency Technology Contact: Helen Mehrkens (907) 465-8730
• Technology Literacy Challenge Fund
  FY 1997: $1 million
  FY 1998: $2.1 million
• Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $1.2 million
• Number of Students: 126,015
  Student-Multimedia Computer Ratio: 16:1
• Number of Teachers: 7,644
  Technology-Trained Teachers: 21 percent

Achieving technological equity is a challenge in every state, but nowhere is the task more difficult than in Alaska.

Districts in such populated cities as Fairbanks or Anchorage are as well-equipped with computer labs and other technological resources as many districts elsewhere in the country, says Rick Cross, the state’s deputy education commissioner.

But most schools in the remote Alaskan bush lack telephone lines and must depend on satellites to maintain contact with the outside world. Because of the extra time required for satellites to transmit data, Internet connectivity in rural schools is virtually impossible, educators say.

“Achieving equity in Internet access has been the state’s first priority,” says Ann Derby, the Alaskan technology director for the Northwest Regional Technology in Education Consortium, a federally funded organization that provides technological assistance to six states. “But at this point, more than 50 percent of the districts don’t have it.”

46 TECHNOLOGY COUNTS

<table>
<thead>
<tr>
<th>State</th>
<th>Computer Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade 4</td>
</tr>
<tr>
<td>Public schools</td>
<td>Available Computers</td>
</tr>
<tr>
<td></td>
<td>Percentage of Students</td>
</tr>
<tr>
<td>In classroom</td>
<td>30</td>
</tr>
<tr>
<td>In 2 or more in classroom</td>
<td>28</td>
</tr>
<tr>
<td>In laboratory</td>
<td>21</td>
</tr>
<tr>
<td>In 21 or more in classroom</td>
<td>11</td>
</tr>
<tr>
<td>In laboratory</td>
<td>11</td>
</tr>
</tbody>
</table>

SOURCE: NCES, NAEP, 1996.
And while state officials have been negotiating with telecommunications companies to install more advanced infrastructure to serve rural schools, industry officials have not moved to do so because the population bases are too small to support the cost of an initial investment, says Nick Stayrook, the director of planning and evaluation at the Fairbanks North Star Borough School District.

“It just doesn’t pay for the large telecommunications companies to give them that kind of access,” Stayrook says. “They’re looking at other, high-tech ways to do it, but it’s just not happening.”

State educators are banking on the pending federal “K-rate” telecommunications discounts to make it more financially feasible for rural districts to gain better access to technology, Cross says.

For districts in the state’s more densely populated areas, technological innovation has depended largely on the resources available in local communities. The state has made some important contributions to various districtwide initiatives, Cross adds, but it has not provided the funding for a consolidated, statewide effort.

For a financially squeezed district like Anchorage, that means its technology plan is not being implemented as rapidly as many would like, says Norm Holthouse, the district’s technology director.

“We know where we’re going and we’ve made progress,” he adds. “But we suffer from a lack of resources, so it’s going to be a slow process.”

This year, the district was helped by a state-funded effort through the Alaska Science and Technology Foundation, which provided grants of up to $10,000 to 326 schools across the state for networking purposes.

Using that money, and the help of volunteers who donated time to help wire the district’s schools on designated NetDays, the district has broadly expanded its networking capabilities, Holthouse says. But many of the district’s schools don’t have enough computers and are “bare bones” when it comes to support staff, he says. “The state has not provided us with extra money there.”

Despite its lack of funding, the department of education is clearly supportive of districts wishing to do more to integrate technology in their classrooms, Stayrook says.

“We know the state doesn’t have a whole lot of money either,” he says. “But they have done a lot in the way of motivating schools to use technology”

Alaska educators say the private sector has helped pick up some of the slack.

British Petroleum, the state’s leading oil company, donated several hundred used computers to the schools last year. In the process, the company set up 25 technical training centers and paid for teacher training, software, and cables for schools that received the computing equipment. —JESSICA L. SMITH

ARIZONA

• State Education Agency Technology Contact: Alex Belous (602) 542-5080
• Technology Literacy Challenge Fund: FY 1997: $2.8 million FY 1998: $4.1 million
• Selected Other Federal Resources for Technology: Department of Commerce TIIAP: $749,458
• Number of Students: 749,759
• Number of Teachers: 38,509
• Technology-Trained Teachers: 13 percent

Arizona’s schools are clearly hungry for technology.

The state education department wanted to give away nine donated multimedia projectors earlier this year. It received 142 applications from districts and schools.

But for a variety of political and financial reasons, larger-scale state support for technology has been slow in coming.

“Most large school systems are pretty well ahead,” says Hank Stabler, the technology director for the 29,000-student Peoria Unified school district, one of the state’s larger suburban systems.

“The community demands it and passes bonds to fund it. But within smaller school systems, there’s a huge range.”

That range is in part the result of the vast disparity among Arizona districts’ property wealth, which determines how much money school systems can raise for school-construction and -maintenance projects—let alone technology.

For the past three years, the state has been embroiled in a school-finance lawsuit that seeks to lessen the disparity. In the meantime, observers say, lawmakers are unlikely to provide a hefty cash infusion for technology.

“It’s hard to address the technology when the roof leaks,” quips a white paper on legislative priorities drawn up by the Arizona Learning Technology Partnership, a public-private alliance launched a year ago to help support the state’s K-12 technology push.

Arizona’s main technology goal for K-12 schools is for every student to have equitable Internet access by June 1999. To date, between 60 percent and 70 percent of all public schools in the state are connected, says Alex Belous, the state education department’s director of Internet and learning technologies.

Lisa Graham Keegan, the state’s elected Republican schools chief, is a booster for technology uses that promote greater public accountability. Such efforts include publishing school report cards on the Internet and developing ways of tracking students and spending down to the school level.

It is no accident that these are Keegan’s priorities: She heartily supports a free-market education system in which parents can use taxpayer dollars to choose from a wide range of public, private, and parochial schools.

Notwithstanding the superintendent’s enthusiasm, Stabler sees a leadership void in school technology.

“In this state, we have not seen any champion,” says Stabler, who heads an informal group of district technology directors. “And on the one hand, we want to invite high-tech companies here, but on the other hand, we don’t want to invest in the technology literacy of our students. There’s a real disconnect.”

Arizona’s political climate makes it difficult to coordinate technology efforts statewide, some say, because local control reigns supreme and state mandates are anathema.

“The state role is really to pilot: Let’s think it up, let’s try it out, find a partner, and have at it. And then we step back,” Belous says.

The emphasis on local control has affected technology funding as well. To date, school technology dollars have come almost exclusively from local districts and the federal government.

Arizona received $2.7 million from the federal government’s Technology Literacy Challenge Fund. The state has already doled out its first 100 connectivity grants, at $5,000 per connection, mostly to smaller, more rural districts that historically have been underserved technologically. The grants translate into a full-time, plugged-in Internet connection.

Comprehensive implementation grants of up to $150,000 are being distributed to school systems that already have basic connections, but need to beef up their infrastructure or teacher training.

“It’s moving on to the next step, which is desktop Internet access,” Belous says. But the real challenge for schools, he says, is to integrate technology into the curriculum.

“The buzzword is curriculum integration, but no one really knows what that means. We talk about getting access, but it’s like, I have a telephone, now who do I call?” —LYNN SCHNIBBERS
Arkansas continued from Page 47

“...we’re still behind on instructional use,” Boardman says. “We’ve really moved forward on connectivity and administrative [uses of technology]. Now, we need to move into the classroom and into professional development.”

The state’s recently updated technology plan suggests strategies to do that, Boardman says.

Meanwhile, he says, one initiative already in the works is likely to help. The legislature recently earmarked $200,000 to set up two-way interactive video capability at Arkansas’ 15 regional education cooperatives. Such technology will help the centers deliver all types of training programs—including those dealing with technology—to educators across the state.

In addition, it will give students access to teachers and courses beyond those available in their own districts. Aiding in the effort is the Arkansas Education Television Network, which is providing the regional cooperatives with programs to air in every K-12 subject area, says John Cheek, AETN’s director of learning services.

At the district level, interest is growing in what technology can do for students, Boardman says. Recently, 167 districts—more than half the state’s total—applied for a piece of the $2.1 million Arkansas received from the federal government in Technology Literacy Challenge Fund money. He said the state has reserved $450,000 of the sum for districts that have high poverty rates and a greater need for technology.

Technology, he says, “will be equalizing if we use it correctly. If you’re in a rural place where it’s very hard to bring in a depth and breadth of programming, where it’s difficult to have access to the information and resources available, it will help tremendously.”

—JO ANNE NATEL

Computer Availability

Public school teachers’ reports on the availability of computers to students in mathematics classes.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage of Students with Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>40</td>
</tr>
<tr>
<td>II</td>
<td>53</td>
</tr>
<tr>
<td>III</td>
<td>42</td>
</tr>
<tr>
<td>IV</td>
<td>39</td>
</tr>
<tr>
<td>V</td>
<td>37</td>
</tr>
</tbody>
</table>

SOURCE: NCES, NAEP, 1996.

For a state that has lagged behind many others on numerous measures of educational quality, Arkansas has made significant strides in school technology. This school year, for example, every school and district office in the state will have access to the Internet through dedicated telephone lines.

One reason is that Arkansas has had educational technology on its agenda for a long time. Its commitment started in 1983, when the legislature authorized a partnership between the state department of education and a nonprofit company to provide schools with microcomputers. Known as Project IMPAC—Instructional Microcomputer Project for Arkansas Classrooms—the program helps schools develop technology plans, build the infrastructure for technology, buy hardware and software, and train teachers, says Cecil McDermott, IMPAC’s program manager.

The legislature gives the education department $2.7 million a year to channel to IMPAC activities, which exist in “every school in one way or another,” McDermott says.

Another prong in the state’s multilevel effort to bring technology to schools is the Arkansas Public School Computer Network. Like IMPAC, the project is a partnership between the state and a nonprofit company. It was conceived in 1991 to develop a statewide computer network that would link public schools to each other and to the education department, primarily for administrative purposes. It also has been the driving force behind connecting schools to the Internet.

Since 1992, the legislature has funneled $41 million into the network’s efforts, according to Bob Friedland, the program’s director. James Boardman, the state’s assistant superintendent for information and technology, says Arkansas will focus next on increasing classroom uses of technology and giving more individual classrooms—not just schools—Internet access.

School technology has never been one of California’s strong points. Instead, it’s been something of an embarrassment.

“For the state that’s home to Silicon Valley, that started NetDay and that’s been innovative in technology in a number of ways, California has done very poorly in putting computers in the hands of teachers and students,” says Glen Thomas, the newly named manager of educational technology for the state department of education.

The state is poised for big changes, however. In the past few months, California has unleashed two major undertakings to build the technological infrastructure in schools and to improve teacher training.

Under the Digital High School initiative, lawmakers will dedicate more than $1 billion over four years to boost the level of technology in California schools. Two hundred high schools—“their names drawn in a lottery”—will be the first to benefit from the program, receiving $300 per student this school year to vote to technology.

“It’s the largest amount of funding this state has ever had for technology,” says John Crawford, San Francisco-based technology researcher and consultant who helped develop the guidelines for the Digital High School program.

The money, which districts must match with local funds, will upgrade hardware and software, provide students and teachers with direct Internet access, and train teachers in how to use the technology to achieve curriculum goals, Thomas says. Over four years, between 400,000 and 1 million computers will be added to high schools.

“Instead of introducing technology to schools in a piecemeal way, as state educators have done so far, we’ll totally fund the whole ball of wax right now,” Thomas says.

In September, Republican Gov. Pete Wilson signed into law another major technology initiative, one requiring new teachers to have basic skills in technology before setting foot in the classroom.

The law doesn’t take full effect until 2000, but it enlists the California Commission on Teacher Credentialing to determine what constitutes basic skills. Likely components will include a basic understanding of hardware systems and familiarity with e-mail and other telecommunications services, says Rod Santiago, the commission’s legislative liaison.

The law is significant because California expects to hire thousands of teachers over the next several years as the student population rises, older teachers retire, and class sizes drop.

Other efforts aimed at improving school technology are already at work in the state. Among them:

• Federal and state grant programs. This year, California is projected to get $49.5 million under the federal Technology Literacy Challenge Fund; last year, it received $20.6 million. In addition, for the past three years, California has funded its own $10 million grant program to advance technology in schools. In either case, schools can use the money for technology, or they see fit.

California continued on Page 52
California continued from Page 50

- The California Technology Assistance Project. For the past two years, the legislature has devoted about $2.5 million a year to this network of 11 regional agencies that assist districts with technology. The agencies’ job is to help districts make technology purchases, to provide technical training to teachers, and to advise schools on developing technology plans, Thomas says.
- Project GlobalNet. This effort seeks to link districts to the state department of education so that they can quickly exchange administrative data, such as attendance counts and curriculum reports.
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democratic Gov. Roy Romer this year called for $25 million in grants and another $20 million for professional development. But the budget request fell victim to other priorities, and the legislature appropriated no state funds for education technology.

On paper, at least, Colorado has a strong vision for education technology.

The state’s lengthly education technology plan, released last March, calls for Colorado to integrate technology with the state’s subject-matter content standards and to take the lead in building the infrastructure for networked classrooms and schools. The state already has “information literacy guidelines” and its technology plan contains a proposed set of technology standards. While the standards haven’t been adopted, they go well beyond broad generalities to such specifics as how many words per minute a 5th grade student should be able to “keyboard” (12-15, using touch skills 50 percent of the time), and when students should be able to create documents (2nd grade) and manipulate databases (4th grade).

Local control of schools is a bedrock principle in Colorado, so even Fedor acknowledges that “districts are way ahead of what the state is doing.” In Colorado’s largest district, Jefferson County in suburban Denver, officials last year sought to come up with a way to distribute education technology most equitably among its 137 schools.

John Canuel, the district’s instructional technology coordinator, says that PTA groups at some schools would raise money for computers on a regular basis, while schools in poorer neighborhoods got few extras.

“Our district PTA wanted to get out of the technology business,” he says. So the district came up with a plan in which all schools lease their computers from the district.

“We come in and buy out all the equipment in the schools,” Mr. Canuel says. “We’ve been doing it for 15 years with copiers.”

Now, computers in Jefferson County schools are phased in on a five-year cycle, meaning all schools have some of both new and older-model machines.

“It is slower growth, but every six months each school gets some new computers,” Mr. Canuel says.

He adds that he has had “almost zero” contact with the state on technology issues. “All of our technology funding is coming right out of our general budget,” he says.

Many districts are turning to corporate and private technology providers for support. In Denver, the US West Foundation operates the Curtis Park Technology Center, a neighborhood-based place for disadvantaged children, welfare recipients, and senior citizens to come in to surf the Internet or work on a resume.

US West, one of the Baby Bell regional telephone companies, has also partnered with the Denver district to offer discounted Internet accounts to district employees and parents. The company gives $2 of every $12.95 monthly fee per account back to the district.

With the state pouring millions into technology infrastructure for schools, experts say Connecticut could do more in other areas of educational technology.

“The state has carved out the role of infrastructure, not necessarily of hardware and training,” says state Rep. Denise W. Merrill, a Democrat who has been the legislature’s main proponent of school technology. The legislature allocated $10 million for technology infrastructure in the 1995-97 budget, and that figure will rise to $20 million in the 1997-99 budget.

From that pot of funds, $1 million will be given to each of the largest districts in the state: Hartford, Bridgeport, and New Haven. The remaining funds will be distributed through competitive grants in which districts with technology plans will vie for money to pay for wiring, hubs, routers, servers, and local area networks.

Legislators are taking a wait-and-see attitude before committing to technology in other ways, however. They want to see more research on the effectiveness of school technology and to avoid mistakes that other states may now be making. Besides, fiercely independent local districts and towns often

Education Week • November 10, 1997

[Image: Bar chart showing the availability of computers to students in mathematics classes.

Computer Use

Public school third-graders’ reports on the availability of computer use for mathematics.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Almost every day</th>
<th>Once or twice a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>Grade II</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>

SOURCE: NCES, NAEP, 1996.

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<table>
<thead>
<tr>
<th>Grade</th>
<th>Classroom</th>
<th>In laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>58%</td>
<td>31%</td>
</tr>
<tr>
<td>Grade II</td>
<td>60%</td>
<td>29%</td>
</tr>
</tbody>
</table>

SOURCE: NCES, NAEP, 1996.

Colorado fashions itself a high-tech state. It is home to major cable and telephone companies such as Tele-Communications Inc. and US West, and, by one estimate, it has one of the highest concentrations of high-tech workers in the country.

But some Colorado educators believe the state is not taking the lead it should on school technology.

My impression is that Colorado is not very well coordinated at the state level,” says Larry Buchachenko, the technology coordinator for the 21,000-student Poudre school district. “We do informal coordination among district technology coordinators. But the state has not really taken a strong role.”

In 1996, the legislature appropriated $20 million in competitive grants for education technology. The money was available to K-12 schools, higher education institutions, and state libraries.

Democratic Gov. Roy Romer this year called for $25 million in grants and another $20 million for professional development. But the budget request fell victim to other priorities, and the legislature appropriated no state funds for education technology.

“It just didn’t come about,” says Eric Fedor, the director of educational telecommunications in the state department of education. We’re hoping that in the next legislative session, there will be another initiative.

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view state involve-
ment in education
with suspicion.
And technology can
be a tough sell to state
legislators who do not
even have access to e-
mail and the Internet
in their own state of-
fices, Merrill adds.
“We are making
progress, but we need
to focus more on pro-
fessional learning,”
says Merle Harris,
the chairwoman of
the Joint Committee
on Educational Tech-
nology, established by
the legislature to
guide technology de-
velopment. “We as-
sume that our teach-
ers have the skills,” but many do not, she says.

Toward that end, the state plans to use its $1.5
million grant from the federal Technology Literacy
Challenge Fund to offer more professional develop-
ment for teachers. Training will be conducted
throughout the state in Connecticut’s six regional
education service centers.
Carol Rocque, the state technology coordinator,
says she was pleased that the TLCF money is avail-
able for training because none was forthcoming from
the legislature.
“We asked for professional development money at
the state level, but it’s very difficult to get funding
for,” Rocque says.
Technology is slowly making its way into content
standards for students and proficiency requirements
for new teachers, Rocque says. The state’s mastery
tests, administered to 4th, 6th, 8th, and 10th
graders, will soon have more technology components.
The state has done a fair amount of planning for
technology, Rocque says. Its technology plan was de-
veloped over a two-year period and is due for an up-
date next year.
In addition, the joint committee headed by Harris
includes representatives of schools, higher education
institutions, libraries, and businesses. The commit-
tee aims to link services among schools, public li-
braries, and universities and colleges to avoid creat-
ning systems that can’t speak to each other.
A perennial struggle in Connecticut—providing
equity among poorer and more affluent districts—
spills over to educational technology as well. A peer
review of the state’s TLCF application flagged a con-
cern that the state’s poorest districts would lag be-
hind wealthy districts in the planning and develop-
ment of technology.
“There are some districts in the state that are not
coming up to speed at all, particularly the smaller,
rural ones,” says Ted Merritt, the chairman of a tech-
nology committee of an association of Connecticut
school superintendents.
And he, like others, says the state as a whole has
a long way to go as well.
“We know we’re not where we should be, but being
a little behind puts us in the position to leapfrog,”
Merritt says.

DELAWARE

- State Education Agency Web Site:
 www.doe.state.de.us/

- State Education Agency Technology Contact:
 Thresa Vendryz Kough (302) 739-4692
- Technology Literacy Challenge Fund
  FY 1997: $1 million
  FY 1998: $2.1 million
- Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $223,183
  1997 Technology Innovation Grant: $1 million
- Number of Students: 110,549
- Student-Multimedia Computer Ratio: 14:1
- Number of Teachers: 6,642
- Technology-Trained Teachers: 10 percent

Computer Availability
Public school teachers’ reports on the availability of
computers to students in mathematics classes.

Computer Use
Public school 8th graders’ reports on the frequency of
computer use for mathematics.

Computer Use
Public school 8th graders’ reports on the frequency of
computer use for mathematics.

Computer Availability
Public school teachers’ reports on the availability of
computers to students in mathematics classes.

Computer Use
Public school 8th graders’ reports on the frequency of
computer use for mathematics.
Blessed by its small size, Delaware has taken an active role in upgrading school technology, wiring schools, and promoting business involvement. State officials are in the process of building an "education data network" that will provide all of Delaware's 7,000 classrooms access to various types of technology. Gov. Thomas R. Carper, a Democrat, has also made school technology a priority during his two terms, tying it to economic development.

In a recent speech, Carper called technology "a critical element" to help further the state's academic standards and boost local curricula. "We're making an investment—an enormous investment at that—in the future of our entire state and nation," he said.

Much of that investment began in 1994, when Delaware received a $220 million windfall from a U.S. Supreme Court case concerning the heirs of deceased business owners who had offices in New York but lived in Delaware. State officials decided to set aside $30 million of the settlement to upgrade school technology.

Their first goal—scheduled for completion next year—was to wire every classroom for state-of-the-art technologies, including computers, fax machines, and video. So far, the state has made large strides. The library in each of Delaware's 180 public schools has already been connected to the Internet, and librarians are now working on providing students with online resources, including magazines, journals, and encyclopedias.

The wiring project will "make substantial improvements in terms of equity in access to information," says Tom Sloan, a librarian for the state government and a board member of the Delaware Center for Educational Technology, the group coordinating the Internet wiring.

Delaware has also enlisted federal AmeriCorps volunteers to help recycle used computers donated from government offices and local businesses. So far, about 200 computers have been sent to classrooms via that route, says Sheri Woodruff, a spokeswoman for the governor's office.

Earlier this fall, top district officials gathered at a summit to discuss their next step—how to integrate technology into the curriculum. Only 15 percent of classrooms had modern computers in fiscal 1997, compared with 5 percent in fiscal 1996, and only 20 percent of classrooms had effectively used technology in the school curriculum in fiscal 1997, compared with 5 percent in fiscal 1996, according to state data.

State education officials are "really making strong efforts to tie technology to what kids and teachers are being asked to do," says Theresa Vondrey Kough, the state's education associate for libraries and technology. "It's not just technology for technology's sake."

About 20 percent of the teachers in buildings that have received wiring have completed training to use the technology and better understand the Internet, according to state estimates, and the University of Delaware has offered free classes to train teachers on using technology to improve instruction.

Delaware's board of education is also considering a proposal that would require "competence in the
Florida is one of the nation’s leaders in school technology, and financial resources are a major reason why. Over the past five years, state lawmakers have appropriated $445 million to the cause.

“Florida’s always put a lot more money and a lot more commitment into [school technology] than most other states,” says John Cradler, an educational technology researcher and consultant based in San Francisco.

So far, the money and planning have shaped this technology scene:

- **Educators** have access to the Florida Information Resource Network, a statewide network connecting public school districts, community colleges, state universities, and libraries.
- Many older schools have used an $80 million retrofitting program sponsored by the state to upgrade their buildings to take advantage of technology.
- Every school has a videodisc player, purchased at state expense.
- Florida has emphasized the importance of teacher training in technology by requiring districts to spend 30 percent of their state technology dollars for that purpose.
- Technology is linked to the state’s academic standards; all the core subject curricula incorporate the use of technology as a teaching and learning tool.

“Our strong point is that we were early adopters of technology,” says Peter Lenkway, an administrator in the office of educational technology at the Florida Department of Education. “We have a large institutional base of technology in schools, and we’ve had a variety of initiatives over the years that have pointed teaching and schools into the future.

One of the most lauded initiatives is the state network, FiRN. Conceived in the early 1980s as a network to link schools for administrative purposes, FiRN has added other functions. Today, it supports 50,000 free e-mail accounts for teachers; serves as an Internet provider for schools; features its own Web server, which gets about 200,000 hits a week; and allows school officials to make use of its services.

“FiRN is a valuable resource, and Florida is lucky to have this as part of the infrastructure,” concluded a review panel evaluating state applications for the federal Technology Literacy Challenge Fund.

State funds pay for FiRN, and all the state’s districts have access to it—90 percent through direct connections and 10 percent through dial-up accounts. Each district, however, is responsible for connecting its schools to the system through a wide-area network—and that leaves some schools wanting.

“Some districts have all their schools connected; some don’t,” says Bill Schmid, FiRN’s director.

Making access to technology more equitable is a challenge in Florida, where state money is divided among districts on a per-pupil basis. Smaller, poorer districts have a hard time affording expensive technology, Schmid says, and are anxiously awaiting the distribution of federal “E-rate” discounts on telecommunications services.

State officials also hope to increase the number of modern computers in Florida classrooms. Even though the student-to-computer ratio is low—at 6 to 1, according to state figures—officials point out that this figure includes outdated models.

“We have a lot of old equipment,” Lenkway says. “For example, we have 69,000 Apple IIs in schools.”

The state has recommended that districts come up with a plan to replace old computers, he says.

Another challenge in Florida is getting teachers all the training they need in technology, without depriving students of instructional time, he adds. The state is exploring ways to train teachers without asking them to leave their schools and students, such as distributing CD-ROMs featuring technology instruction and using the state’s satellite transponder to deliver instruction.

—JO ANNA NATALIE

The story of educational technology in Georgia is a two-part tale: before the lottery and after the lottery. Before 1994—the first year schools started receiving the benefits of the state’s lottery for education—districts were pretty much on their own if they wanted to spend on technology. Since then, the lottery has pumped more than half a billion dollars into technology for schools and universities. That money has been a catalyst for districts to make their own investments in technology.

“Folks assumed that [the lottery] would be a short-lived initiative,” says Bailey Mitchell, the director of instructional technology for the Georgia Department of Education. “But it’s become an institutionalized part of the budgeting process.”

Just this year, almost $37 million in lottery funds were sent to districts for hardware and software. The legislature also approved $15.4 million to pay for district technology specialists.

The money—distributed on a per-student basis—has established a base of technology in the schools, while still giving districts flexibility to buy the equipment and software they prefer. That demand for local control, however, can lead to uneven use of technology in the schools, leaving some legislators disillusioned.

“There are schools that are benefiting greatly, and there are schools that don’t understand what we’re doing,” says Rep. Jeffrey L. Williams, a Republican from suburban Atlanta who serves on the

Florida, November 10, 1997 - Education Week
In the midst of a continuing fiscal crisis that has sliced most state services, the Hawaii legislature this year approved one of its largest investments in educational technology.

The state will pour more than $17 million in the 1997-99 biennium into building the infrastructure needed to wire every classroom to the state computer network and provide Internet access and multimedia capability to every teacher and student. The funding is more than 10 times the previous biennium's allocation for school technology.

One lawmaker says the increase represents a shift in thinking among lawmakers, many of whom now see technology as a key to addressing the state's economic woes.

"I have been most interested in the way technology can accelerate and enhance economic development," says state Sen. Carol Fukunaga, who chairs the Senate ways and means committee. "In the past, there has been more of a focus on the bricks and mortar needs of schools. We now have a cadre of legislators who can see the value and need for computers."

The state's next priority should be to provide better maintenance for its school technology, Sosa says. "We probably have a lot of computers and systems that are not being used to their capability because we haven't had the technical support to help principals and teachers maximize their effectiveness."

—KATHLEEN KENNEDY MANZO

SOURCE: NCES, NAEP, 1996.
Idaho has made a steady financial commitment to school technology since 1994, when the legislature enacted the Idaho Technology Initiative. While that piece of legislation calls for annual spending of $3.4 million, lawmakers have added another $7 million for technology in one-time funds each year. The annual total of $10.4 million is not an inconsiderable amount, considering that Idaho has just 240,000 students.

The money—consisting each year of $20,000 base allocations to districts with technology plans, plus $35 per-pupil allocations—has gone a long way toward increasing the hardware available in schools. A 1990 state survey put the student-to-computer ratio at 26-to-1. Today, it’s 6-to-1, says Rich Mincer, the chief of the Idaho Department of Education’s bureau of technology services. The national average is 7-to-1, according to the research firm Market Data Retrieval.

Idaho’s technology plan hopes to bring the state’s ratio down even more. “Our minimum goal is 5-to-1; our optimum goal is 3-to-1,” Mincer says.

Other money has helped propel advances. All the funding the state received from the federal Goals 2000 program has been applied toward technology, as has $4.5 million contributed in 1996 by the state public utilities’ commission because of customer overcharges.

In addition, the legislature has given the state’s four schools of education $1 million a year since 1995 to train district-level teachers in technology, primarily in its integration into the classroom. Partnerships with Hewlett-Packard Co. and Micron Technology have assisted schools as well, providing new and used computer equipment, training for educators, and financial assistance in connecting schools to the Internet, Mincer says.

As of last year, about a third of Idaho’s schools still lacked access to the Internet. Getting them hooked up is one of the state’s most pressing goals, Mincer says.

Several other initiatives are in the works. The state board of education is reviewing a proposal for minimum technology standards for teacher certification. Also, the state is developing curriculum guidelines for all subjects and exit requirements for high school graduates. Once those are drawn up, the plan is to weave use of technology throughout the recommendations, Mincer says.

The state is also conducting a statewide review of the impact technology is having in the classroom. The results are due Jan. 1.

One of the groups awaiting the review’s results is the legislature. “We need to demonstrate what we’ve done with the money the legislature has given us so far and where we’re going with it,” says Mike Howard, the principal of Payette Lakes Middle School in McCall and a member of the Idaho Council for Technology in Learning.

“The legislature has dedicated money toward technology, but they’ve just whetted our appetites,” Howard says. “The more we learn about technology, the more we want to learn.”

—JO ANNA NATALE

**Illinois**

- State Education Agency Web Site: www.isbe.state.il.us/homepage.html

Illinois continued on Page 60
Illinois lags behind states with comparable K-12 enrollments in investing in technology but it’s trying to catch up. Policymakers would like to use their tax revenues to ‘learn from other states’ mistakes and do it right,” the state’s information technology plan says. With no dedicated source of funding for technology, Illinois districts have been left largely on their own. The state’s dramatic gaps in wealth among districts, not surprisingly, have produced similar disparities in distribution of technology.

That picture is starting to change, however. Legislators approved $15 million for educational technology in fiscal 1996, $30 million in fiscal 1997, and $44 million this year. The state’s plan calls for hefty increases in the future, to $194 million in 2000.

Gov. Jim Edgar, who annually hosts a technology summit, has been a strong supporter. In 1996, he called for all Illinois districts to have high-speed connections to the Internet by 2000.

State officials say that while it’s important to help students gain access to modern machinery, they’re even more interested in using technology to help transform classroom practice. Statewide, there are 20 students for each multimedia computer, according to a recent report by the state Data Retrieval.

“It’s easy to get locked up in the whole glamour of equipment,” notes Luzene Finley, the acting associate superintendent for technology. “We know that the equipment is merely a tool to help us improve student learning.”

As an example of what they’d like to see, officials point to a state project that has connected eight museums with 260 classrooms around the state. Students have access to museum artifacts and can explore information and ideas in consultation with curators.

“If a teacher is open to allowing students to construct their own knowledge, she runs a very different education,” notes Mary Jo Erdberg, the director of the state Museum of Science and Industry.

The hub strategy also allows the regional centers to specialize in areas that have large numbers of low-income students. Districts must spend a minimum of 25 percent of the funds on training teachers to use new learning technologies, notes Sharmo Roberts, a policy adviser on technology at the state education department. This focus on professional development, along with the state’s clear vision for the role that technology should play in education, earned it kudos from the panel that reviewed Illinois’ TLCF application.

But the level of interest in the grant program underscores the hunger for learning technology among Illinois districts. The state received 664 applications, Finley says, but could fund just over 50.

The state’s technology plan calls for the legislature to identify a revenue source to support an annual per-pupil allocation of funds. In fiscal 1996, the most recent year for which data are available, Illinois spent $8 per student on technology, compared with $70 in Ohio, $65 in Georgia, and $51 in Florida, according to the Illinois technology plan.

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Indiana

- State Education Agency Web Site: www.dee.state.in.us
- State Education Agency Technology Contact: Mary Jo Erdberg (317) 232-9119
- Technology Literacy Challenge Fund FY 1997 $3.1 million FY 1998 $6.3 million
- Selected Other Federal Resources for Technology Department of Commerce TIIAP: $3.1 million 1997 Technology Innovation Grant: $1.4 million
- Number of Students: 584,610 Student-Multimedia Computer Ratio: 19:1
- Number of Teachers: 68,412 Technology-Trained Teachers: 15 percent

Indiana doesn’t provide much in the way of state aid for educational technology, so a district’s progress depends largely on the interest and wealth of its local community. But the state began with poorer districts and will reach all the state’s 4,100 schools connected.

In 1995, the state board of education launched “learning technology hubs,” now in seven locations. These regional offices provide technical assistance and professional development to local districts.

The hub strategy also allows the regional centers to work with districts to ensure that their purchases fit within the larger state framework. “A consistent program for all schools is vital, so we aren’t going out with everybody getting their own deal and their own provider and creating a network nightmare,” says state Sen. Thadstick, Mike Huffman, a Republican from Kokomo, says.

At the same time, a couple of statewide technology programs have been quite successful. A program called the Buddy System, started in 1987, has placed computers in the homes of elementary students at 70 schools. And the Indiana Technology Learning Center at Butler University in Indianapolis, which is operated mostly with state money, trained 3,500 teachers, principals, and superintendents last year.

In 1995, the Indiana General Assembly approved $36 million in school technology funding for a two-year period, on top of $5.6 million it has allocated each year since the early 1990s. The $36 million came from gaming money—the lottery, charity bingo, horse betting, and riverboat gambling.

For the current two-year budget cycle, which started in July, the state Senate wanted to shift the source of the school technology money to the general fund. But the House disagreed, and the legislature ended up approving $40 million from gaming sources, plus continuing the $5.6 million a year from the general fund.

Some technology advocates were disappointed.

“Education depends on something as fluid as lottery dollars, some years we may have disappointment,” Usher says. “I would like to have general-fund rather than gaming revenue.”

Indiana hopes to use its technology funding to address the inequities in its public schools, which have a state Technology Plan Grant Program, launched in the 1996-97 school year, will give each school district a set per-pupil amount of money for technology. The state began with poorer districts and will reach all districts in five years.

The department of education is requiring school districts that receive grants to have a five-year technology plan in place and to pitch in one year’s worth of its capital-project fund money.

In the meantime, the state has some catching up to do with its own planning. The department of education— with input from legislators, businesspeople, and school personnel— has developed a state technology plan that lists four priorities: planning, professional development, access (including infrastructure), and funding. However, the plan isn’t very detailed—it’s only four pages long—and has no deadlines or costs assigned to any of the proposals. The legislature does not have to approve it.
“It’s a reactive plan, not a leadership plan,” says Huffman, who adds that he’s working on a better one.

Usher says an “iron-clad, concrete plan” is not always the best idea. She admits that, “in some respects, it’s not good” that the legislature doesn’t approve the technology plan, because “we don’t have ownership from top to bottom.”

“On the other hand,” she says, “the freedom you’ve given outside the political process makes for faster movement.”

—MARY ANN ZEHR

Iowa’s heavy investment in planning for educational technology is starting to show results. The state is about to complete the second year of an ambitious five-year program in which $30 million is allocated each year to districts for, among other items, hardware, software, and infrastructure. The money is distributed on a per-pupil basis, with a minimum of $15,000 given to the state’s smallest districts. Another $450,000 goes to fund regional area education agencies to provide technical assistance to schools.

Pouring all this money into technology improvement has given some legislators pause about what will happen in the future, says state Rep. Libby Jacobs, the chairwoman of the legislature’s oversight committee that handles all technology issues.

“The discussion now is what happens in year five when we’ve got all this equipment,” Jacobs says. “Maintenance and updating will be issues.”

In the meantime, all that a district has to do to receive its money from the state technology program is offer a one-page proposal laying out its plans. Districts do not have to spend their allotments each year, but can earmark them for bigger

Iowa continued on Page 62
projects later in the five-year program. "Some districts may want to go slow, do a needs assessment over two or three years, and then make a decision on how to spend it," says Klark Jessen, a spokesman for the state education department.

That is a novel approach for Iowa, says Ann Molis, the state education department's legislative liaison. "In Iowa, we're more cash-and-carry. We don't usually operate that way."

Technology continues to draw the interest of state leaders. A recent report from the Governor's Commission on Educational Excellence for the 21st Century includes numerous proposals for increasing school technology. Gov. Terry E. Branstad was scheduled last month to hold 10 public hearings on the recommendations, and is expected to propose legislation based on them in his legislative package, Jessen says.

Attracting much attention is the commission's recommendation that, with the support of the private sector, every Iowa student in the 4th grade and above be given access to a laptop computer. Other recommendations include extending funding for technology beyond the five-year program, incorporating the use of technology into school-improvement plans, and continuing use of the Iowa Communications Network to enhance student learning, teacher development, and parent involvement.

The ICN is a $200 million project launched in the late 1990s that will eventually connect all the schools in the state. It currently links all the state's community colleges and at least one site in each of Iowa's 99 counties, as well as a limited number of schools. By 1999, the network will be installed in at least one high school in each district.

Schools use the ICN in a variety of ways, including providing Internet access, carrying long-distance phone calls, and conducting distance-learning projects, such as interactive video sessions with colleges. Other schools have tapped the system to exchange data with the state education department, says Rich Gruss, the director of technology for the state education department.

Gov. Branstad strongly supports the network, but it has a number of critics. Pressure from dozens of small telephone companies in the state has led some legislators to consider selling the system to a private company. Meanwhile, the state is collecting applications for distribution of the $1.4 million grant that it received from the Federal Technology Literacy Challenge Fund. The money will be given to schools with the highest percentage of students receiving free or reduced-price lunches, Jessen says.

About 30 grants will be awarded, and schools receiving funding must complete their project by the end of September 1998.

"We've got a long way to go," says Andy Tumplins, the state's commissioner of education. "Right now, we're just trying to get connectivity and access." The state board of education will propose in January that the legislature set aside $11.5 million for new equipment, Internet access, and teacher training. The money will be a modest start, Tumplins says, and state officials know it won't pay for everything they want.

"There's a worry that [technology] is a big hole," he will be sure to tell his colleagues. "We don't want to go in and give them sticker shock."

Even the $11.5 million will be difficult to fund, says one legislator who'll play a leading role in the plan's fate.

Lawmakers already plan to boost spending for universities and community colleges and will be under pressure to do the same for the state's K-12 per-pupil allocation, says Sen. Barbara Lawrence, a Republican from Wichita who is the chairman of the Senate's education committee.

"There's a huge question of where do we get the money when there is so much demand in other areas," she says.

Lawrence says she would prefer to free up money that could go for an initiative to reduce class sizes in the earliest grades. That would probably do more to help children learn basic skills, she says.

What's more, Lawrence says, she and other state legislators don't want to tread on the state's tradition of giving local districts wide discretion over how they run their school systems.

That emphasis on local control has resulted in a "dramatic variation" across the state when it comes to technology, Tumplins says.

While some districts have not begun to plan for school technology, others are operating model programs, he says.

A coalition of districts and a university in the southeastern corner of the state has brought interactive television to 10 schools. Similar partnerships are cropping up throughout the state, he says.

Some districts have won approval for bonds to upgrade their technology. Others are reworking their priorities to pay for new equipment, and others redirected priorities for their general funds to pay for the upgrades.

The 1,200-student Girard school district, for example, has spent $2 million to build a computer network that every teacher can access for tasks as varied as corresponding with parents and each other via e-mail, assessing students' reading ability, and printing their quizzes and homework assignments.

The district also built a technology center where students have access to distance learning and computer labs.

The initiative came about because school board members there are forward-thinking and understand that schools need to change to meet the future's needs, according to Dick Foliasso, the district's coordinator.

Tumplins is trying to create that same sense of initiative on the state level.

"That was the panel that reviewed the state's application for the Technology Literacy Challenge Fund money wrote that Tumplins' enthusiasm "gave the panel a sense of confidence about the state's intention to take those next steps in developing a more comprehensive plan and integrate technology into the curriculum." One of Tumplins' first steps as commissioner was to hire Jayne James to be the state's technology director, a position that had long been vacant.

"Iowa, we're more cash-and-carry. We don't usually operate that way."

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About 30 grants will be awarded, and schools receiving funding must complete their project by the end of September 1998.
Louisiana has registered little progress in the area of school technology until 1996, when the state garnered a $4.8 million challenge grant from the U.S. Department of Education and the National Science Foundation. That grant enabled five urban and rural districts to conduct a range of technology projects. One wired its schools and established a wide-area network. Another concentrated on professional development. But perhaps more important, the grants encouraged businesses, universities, and the state government to lend their support to technology as well. “The change in Louisiana has been dramatic over the last six months,” says Kerry Davidson, who headed a commission that developed a statewide technology plan. “There’s no doubt that the challenge grant was the catalyst. “If we hadn’t had these pilot sites, we’d be having a lot of trouble,” agrees Carol Whelan, the director of educational technology for the state education department. Encouraged by the results of the NSF grant, the state legislature this year allocated $37 million for building technology infrastructure in additional schools. We asked for $75 million, but we were happy to get the $37 million, says Whelan, noting that there was some opposition to the technology funding from teachers who thought the money should go to salaries. Davidson and Whelan say they hope that more funding will be forthcoming. “There’s nowhere to go but up,” Whelan says.

How the $37 million is implemented will be key to securing more money, Davidson says, adding that educators must be able to demonstrate that the technology has led to improved achievement. The $37 million will seek to replicate the challenge-grant pilot program and will be distributed based on need. Whelan worries specifically about the state’s rural schools and says that resources must help bring them up to par. “They have the must in expertise, to get technology, to do the coordination, and to get the grants,” she says. The state also is slated to receive another $5.3 million from the federal Technology Literacy Challenge Fund. Whelan says the money will be used for professional development programs.

“There’s never enough professional development, and trying to get it to statewide is difficult,” she says. Indeed, a statewide survey research showed that 20 percent of the state’s teachers felt they had no computer skills, and another 39 percent felt they were just beginners. Only 5 percent felt they had advanced computer skills.

As with the state funding, the districts with the highest percentage of students receiving free or reduced-priced lunches will get the highest percentage of the TLCF money. The state also hopes to encourage the formation of consortia, with larger school districts helping smaller ones. “We feel that technology enhances instruction,” Whelan says. “It is a tool that can be used. If all kids aren’t expected to use it, it becomes an equity issue.”

Louisiana’s technology plan was developed over 2½ years. The Governor’s Louisiana Educational Achievement and Results Now Commission, or the LEARN Commission, and the state board of education approved the plan in the fall of 1996. The plan has led to widespread change, Davidson says. For example, the statewide survey found that 1,000 of the state’s 1,400 schools now have technology plans. In addition, the state education department previously did not have a division focused on technology. Now, several people work in that area. Louisiana also has benefited from volunteer and corporate interest in technology. Whelan says the state has held NetDay events for the past two years.
Maine has invested in a high-quality distance-learning network and Internet connections soon to be available in all its schools. But some in the state say it’s time to upgrade their computer equipment.

“We’re ahead of other states in fiber optics,” says state Sen. Peggy A. Pendleton, who co-chairs the legislature’s joint education committee. “The next step for us is to get the equipment in the classroom.”

Maine’s schools have about eight computers per student, according to the state department of education. Within three years, state officials aim to cut that ratio in half.

So far, though, no comprehensive program is in place to address local districts’ needs. Pendleton says the legislature will discuss ways to design a program in next year’s session.

In the meantime, districts must depend largely on their own resources to fund technology.

“There are some school districts that are very much involved in upgrading technology,” says Ray Poulin, Maine’s deputy commissioner of education. “Other school districts are very, very strapped and can’t find the money.”

The state’s lean economy of recent years hasn’t helped. With state aid falling below full funding, some schools have been unable to invest in technology.

“We have very good [computer] labs in each of our schools. As far as providing every classroom [with a computer], we haven’t done that yet,” says H. Graham Nye, the superintendent of the Augusta public schools.

“I think you’d find that in every school district.”

What every school will have within the next three years is an interactive video and audio network that will also link it to the Internet.

The state is building the fiber optic network with money raised in a $15 million bond approved by voters in 1996.

State officials chose this form of technology after an intensive planning process in which they decided that it was the best way to allow people in several sites to link up and communicate interactively.

High schools will be on-line first, and every school will have access within three years.

Five high schools and the University of Maine-Orono experimented with the network for the past year.

The network is helpful, one superintendent in the pilot study says, especially because both the audio and video applications are interactive. But he warns that his colleagues need to be patient about getting it running.

“It’s ready now,” says Leon Levesque, the superintendent at the School Administrative District No.
Maine continued from Page 65

16 near Augusta. "The piece we haven’t addressed is how we support staff. How do we make a comfort zone for teachers and students to use it?"

Over the past year, the district’s Halowell High School used the network to arrange for a lecture by an archaology professor at the university. The school plans to start offering Japanese and other foreign languages not readily available in regular classrooms.

In addition to distance learning, the network will give every school access to the Internet. It is powerful enough to give every computer in Halowell High a direct connection to the World Wide Web while still being used as a video classroom.

The Internet access will be free to schools. It’s being paid for out of a $20 million fund created by Nynex to compensate for overcharges to local phone bills.

—DAVID J. HOFF

MARYLAND

• State Education Agency Web Site: sailer.lib.md.us/msde/
• State Education Agency Technology Contact: Barbara Reeves (410) 767-0382
• Technology Literacy Challenge Fund
  FY 1997: $5.5 million
  FY 1998: $2.4 million
• Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $1.2 million
  1997 Technology Innovation Grant: $8.1 million
  $350,002
  $3.4 million
  $6.1 million
• Number of Teachers: 618,947
• Number of Students: 936,794
• Technology-Trained Teachers: 23%

A partnership between the business community and the state has been the driving force behind Maryland’s efforts to bring schools up to speed on education technology.

The state department of education and the Maryland Business Roundtable for Education joined forces in 1993, creating a committee that produced the state’s educational technology plan. That plan went into effect in January 1995.

"If there’s anything that makes this state unique, it’s in the partnerships that are making it happen," says Barbara Reeves, the instructional technology director for the state education department. "Without that synergy, there would be pieces missing."

The first phase of the state technology plan is to provide access and build networks. With the strong support of Democratic Gov. Parris N. Glendening, the legislature in 1996 established Maryland Connected for Learning, a program to wire and equip schools and train staff, and committed about $69 million over five years to fund the effort in 700—or about half—of the state’s schools.

The roundtable had produced previous state technology plans, guided by an interest in making sure public schools were producing competitive students as a way to attract businesses to the state. Glendening supported the current version “more than we could ever hope for,” says June Strecfus, the executive director of the roundtable.

“We knew we had to put some clout behind this," she says. "We’re holding the state to the standard we set.

A survey by the business group on the level of educational technology in the state’s 24 districts found that “there were greater discrepancies within a county than from county to county,” Strecfus says.

As of 1996, about 49 percent of computers in Maryland’s elementary and secondary schools were “high capacity” and nearly 51 percent were “low capacity,” meaning they can’t support Internet access or be used in wide- or local-area networks, according to a technology committee status report released in June. The figures were comparable to national averages, the report says.

The ratio of students to computers, meanwhile, was 7-to-1, a major improvement over the 1989 figure of 18-to-1. The ratio of Maryland students to high-capacity computers was 16-to-1.

While Glendening’s administration has taken the lead in pursuing state funding, officials are also seeking support from the federal and local governments and businesses to implement the plan, according to Major Biddick, Glendening’s chief of staff. This year, the state received a $2.4 million grant from the federal Technology Literacy Challenge Fund, which is being used to award competitive grants of $50,000 to $225,000, depending on a district’s size.

The federal funding really has been good at filling in some of the gaps," Reeves says.

Under the state’s technology program, districts apply for state funds, which may include matching funds, to provide chosen schools with a complete wiring distribution for voice, video, and data. The state education department buys equipment for the schools through a special lease-purchase program.

Computer Use

Public school 8th grade computer use for mathematics.

Computer Availability

Public school teachers’ reports on the availability of computers to students in mathematics classes.

MASSACHUSETTS

• State Education Agency Web Site: info.doe.mass.edu/
• State Education Agency Technology Contact: Greg Redaud (617) 388-3300 ext. 729
• Technology Literacy Challenge Fund
  FY 1997: $3.4 million
  FY 1998: $6.1 million
• Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $1.2 million
  $3.2 million
• Number of Students: 936,794
• Number of Teachers: 64,497
• Technology-Trained Teachers: 15 percent

After giving short shrift to educational technology for years, Massachusetts lawmakers and town signs of greater support. For the first time, the legislature last year approved funding specifically targeting education technology.

"There is a growing recognition that technology is

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not going to go away,” says Greg Nadeau, the chief technology information officer for the state department of education. “You can’t view it as a capital item. You have to view it as an operational item.”

Providing Internet access for schools is a top priority of the state’s technology plan. Other highlights include establishing an information-management system designed to replace all paper transactions between districts and the education department; a professional development system that will include a Web site where educators can learn about and register for training courses; and a procurement system that is expected to save districts money in buying hardware and services.

The legislature’s first funding for technology—a $50 million bond approved in September 1996—provided $30 million in matching grants that districts are expected to use for building computer networks and infrastructure. Applying for grants “nudged [the districts] forward in developing serious plans and budgets” for educational technology, Nadeau says. While legislative support for the technology bond was strong, the funding was viewed primarily as an incentive for districts to spend more money on technology, according to officials.

In June, lawmakers allocated just $2.9 million of the education department’s $7.9 million request for statewide technology initiatives for the current fiscal year. But two months later, in supplemental legislation, lawmakers added $20 million for technology in grades K-12 and $10 million for higher education. The department has two years to spend the money.

About $15 million of the K-12 funding will be distributed in grants, and the rest will be spent on statewide projects, including providing every educator with $25 to pay for Internet access.

“The amount of money the state gives to schools is really a drop in the bucket,” Connie Louie, the department’s technology coordinator, says. “It’s just a leverage to get them to do something.”

Though there’s been talk of another bond bill, some legislators seem leery about allocating more money without seeing evidence that districts are prepared to shoulder the bulk of the financial burden of integrating technology into their schools, estimated at $450 per student per year, says Ray Campbell, the general counsel of the state’s information technology division.

State officials hope to further entice districts to invest in technology with competitive grants awarded out of the $3.4 million that Massachusetts received from the federal Technology Literacy Challenge Fund. About $1.2 million will be allocated in need-based professional development grants; other grants will recognize districts that have model programs and identify projects that could have statewide impact.

Another strong impetus has been provided by the state’s two NetDays, which produced $8 million in contributions of products and services and resulted in the wiring of more than a third of the state’s 1,800 schools. A third NetDay was planned for last month.

Technology officials are also planning on using pending federal telecommunications discounts to help pay for managing school networks, estimated to

Massachusetts continued on Page 68
Massachusetts continued from Page 67

cost $200 million a year, and delivering toll-free ac-
cess for all educators and Internet access to each school, estimated to cost $20 million a year.

Education officials will be watching closely to see what impact the July resignation of Gov. William F. Weld will have on the state's commitment to educa-
tion technology. Some, including Nadeau, say they expect to see increased attention in this area under the acting governor, Paul Cellucci, because of his strong commitment to education throughout his tenure as lieutenant governor and his years as a legis-
lator.

—JULIE MANGLOT

MICHIGAN

• State Education Agency Web Site: www.mde.state.mi.us/
• State Education Agency Technology Contact: Jamey Fitzpatrick (517) 373-6331
• Technology Literacy Challenge Fund FY 1997: $1.5 million
• Selected Other Federal Resources for Technology Department of Commerce TIIAP: $2.5 million
• Number of Students: 1,662,100
• Number of Teachers: 64,200
• Technology-Trained Teachers: 10 percent

Michigan devotes little money to school technol-
yogy, hampering the overall strength of its efforts in this area.

One key weak spot is teacher training. School technology leaders repeatedly cite shortcomings there when describing where Michigan needs to improve.

“It’s one thing to know how to use computers to prepare letters or to send e-mail,” says Jamey Fitz-
patrick, the acting director of technology at the state department of education. “It’s completely another to know software and how to use it as a teaching and learning tool.”

Although the legislature passed a law in 1993 re-
quiring new teachers to know how to use computers for instruction, “different institutions take [the re-
quirements] at varying levels of seriousness,” Fitz-
patrick says.

He and others are also troubled by the number of teachers currently in the classroom who are uncom-
fortable with technology for instruction. “We have staff—through no fault of their own—who were trained to be stand-up-in-front-of-students teachers,” says David Kuhn, an associate executive director of the Michigan Associa-
tion of School Admin-
istrators. “Using com-
puters to teach is a whole new strategy.”

State officials are in the process of re-
drafting Michigan’s five-year technology plan. One area slated for revision, consul-
tants say, is the sec-
tion on professional development, which might recommend of-
fering teachers such incentives as compensa-
tory time or extra pay for partici-
pation in training.

Although Michi-
gan’s expiring plan asserts the im-
portance of teacher train-
ing in technology, the legislature hasn’t dedicated any significant funding to the cause—or to any as-
pect of school technology, officials say.

“We haven’t had any major initiative to deal with funding or infrastructure,” Fitzpatrick says, adding that school technology in the state has depended in large part “on what districts already spend and on federal money.”

This year, the state department of education is di-
viding among districts $8.6 million it received from the federal Technology Literacy Challenge Fund. But that sum, Fitzpatrick says, is no match for the $42 million in requests from districts.

The hunt for money stems in part from recent school-finance reform in the state. In 1994, Michigan voters opted to change school funding drastically by making sales and other taxes—not property taxes—
the main source of school support.

That switch “put a great burden on districts to pass bond issues to fund technology,” says Ric Wilke, the director of technology in the East Grand Rapids public schools. “It’s improving, but a couple of years ago, right after the change in the funding picture, people’s taxes went down, and they were very reluct-
ant to have them go back up again.”

Despite the less-than-rosy funding picture, “dis-
tricts have made significant progress getting the stuff of technology, such as hardware and net-
works,” Fitzpatrick says. “Even so, we have a long way to go.”

Part of the state’s challenge lies in eliminating what Wilke calls a “wide disparity” among individ-
ual district capabilities.

“In some districts, there’s maybe one dial-up con-
nection in the media center, but we also have dis-
tricts where every classroom has Internet access,”

says Wilke, the president of the Michigan Associa-
tion of Computer-Related Technology Users in Learning.

One promising initiative on the horizon: The state is developing the Michigan Information Network, which will link local schools and districts with col-
leges and universities, libraries, health institutions, and businesses across the state. The network—still in the planning stages—will connect existing re-
gional networks and expand on them, says Linda Schatz, the director of the office of the Michigan In-
formation Network.

—JO ANNA NATALE

MINNESOTA

• State Education Agency Web Site: www.education.state.mn.us/
• State Education Agency Technology Contact: Mark Manning (612) 297-3151
• Technology Literacy Challenge Fund FY 1997: $2.3 million
FY 1998: $4.9 million
• Selected Other Federal Resources for Technology Department of Commerce TIIAP: $190,000
• Number of Students: 836,700
• Student-Multimedia Computer Ratio: 20:1
• Number of Teachers: 47,600
• Technology-Trained Teachers: 15 percent

Minnesota lawmakers and state education officials have a vision for educational technology that reaches beyond wiring schools and buying computers.

The state’s plans are based on the concept of life-
long learning, which emphasizes developing technol-
ogy in public schools in conjunction with higher edu-
cation institutions and public libraries.

With strong support from Gov. Arne H. Carlson, lawmakers are committed to providing the funds needed to support that vision. In 1995, the legisla-
ture provided $32.5 million for education initiatives as part of the state’s long-range technology plan. And in July 1997, it further cemented the commitment by appropriating nearly $90 million over two years in new and ongoing initiatives.

“There’s a growing acknowledgment that districts can’t do it alone,” says Theresa Mish, a project ana-
lyst for the division of information technologies in the state department of children, families, and learning.

Minnesota’s main focus has been on building a statewide technology infrastructure to provide access to all students. The new funding includes $12.5 mil-
lion to connect and operate the Minnesota Learning Network, which will connect all higher education in-
stitutions, K-12 schools, and public libraries.

“That’s been a big focus of ours, so that a school district at least has a minimum level of connectivity to get started,” says Mary Mehoshker, a department proj-
ect specialist, says.

In addition to providing Internet access, the net-
work will connect every district to an interactive television system. About 200 of the state’s 425 dis-
tricts currently use the two-way television systems, which have a long history in Minnesota, to provide distance-learning classes. The systems allow groups of schools to share teachers and resources by broad-
casting classes that each school may not be able to afford to run on its own.
Most of the state’s schools—78 percent—have technology plans, according to a 1997 department survey of 1,150 of Minnesota’s roughly 1,500 schools. Eighty-nine percent have access to the Internet, and 48 percent have classroom computers that are connected to others in the school.

Seventy percent of schools have an instructional technology coordinator responsible for supporting teachers in integrating instruction and technology. Forty-six percent of teachers are considered to have advanced skills in using technology in instruction; 35 percent have no skills or are at the beginner level.

One of the highlights of the new initiatives dealing specifically with K-12 schools is $14 million allocated for matching challenge grants to invest in technology equipment, networks, and training. Applicants are required to address staff training, technical support, how they plan to use the technology, and how it will benefit the community. An additional $25 million is provided to all districts according to a per-pupil funding formula.

Another highlight is the establishment of the Minnesota Learning Academy, which is a $2 million partnership of the state, local districts, and private vendors to offer courses for teachers that will emphasize integrating technology into classroom learning.

About $6 million also was set aside to refurbish multimedia computers in a public-private recycling partnership that’s expected to reduce the ratio of multimedia computers in a public-private recycling partnership of K-12 schools from 22-to-1 to 7-to-1 over three years.

The state also plans to target $2 million for federal Technology Literacy Challenge Fund grants toward districts with the highest poverty and greatest need for technology.

But while the state is committed to spending millions on technology, there is no framework outlining how much districts must spend, state technology officials say. If a district wants to take advantage of the Minnesota Learning Network, it must first install its own internal network.

“You have a lot of chicken-and-egg questions playing out here,” says Paul Wasko, the manager of education and training initiatives for the state office of technology.

To apply some leverage, the state requires schools to take certain steps, such as developing technology plans or applying for pending federal telecommunications discounts, as prerequisites for receiving grants. But how those schools spend the money is “fairly wide open and left up to each school,” Mish says.

In Mississippi, a state with relatively little money and low test scores, many officials see technology as the most affordable way to give students access to a quality education and materials available to children elsewhere in the country.

“We’re trying to bring Mississippi up to par with other states with technology in the classroom,” Republican state Rep. Mike Chaney says. “That’s the only way we can keep up from the position we’re in.”

Legislators appropriated $30 million for school technology in 1994, setting aside $1.5 million of that amount to establish a statewide education network. The remaining funds were divided on a per-pupil basis to districts with technology plans.

Before the legislation passed, only a handful of districts had taken substantive steps to integrate technology into instruction, says Nathan Slater, the director of management and information systems at the department of education.

Now, each of the state’s 152 districts has Internet access, and districts are making progress on wiring their schools. Roughly half the state’s 900 schools currently have access, and an average of five schools are hooking up to the state network every week, Slater says.

“There’s been an explosion in Mississippi with educational technology,” he says. “We’ve almost overwhelmed with the number of requests coming in from schools that want to get onto the state net.”

With the establishment of its statewide network, Mississippi is keeping pace with neighboring Southern states, says Kurt Cearley, the coordinator of constituent services for the Southeast Regional Technology Consortium, a federally supported program that provides technological support to 12 states and Puerto Rico.

While the legislature has not dedicated any funds specifically to the integration of classroom technology since its 1994 investment, districts officials say they’re relatively content with the state’s support.

The state regularly sponsors in-service programs for teachers in an effort to ease the districts’ burden of providing technology training. The department of education offers its training in three phases, from beginning to advanced, at computer labs throughout the state, says Helen Soule, the director of educational technology for the department.

From the first session of the first level of training, teachers are taught how to use computers as tools for the classroom, Soule says.

“The very first thing we teach them to do is to make a name tag,” she says. “It’s still at a very basic level.”

The state recently invested in a teacher training program that aims to equip one teacher in every school with “exemplary” skills in technology integration. The three-year program will work through a “tag” model, in which one trained teacher will go on to teach another, Soule says.

And though some of the state’s poorest rural districts are “still catching up” in their implementation of technology, Soule says legislators have implemented various funding equity measures to help level the playing field, including a new Adequate Education Program that will help balance total spending in school districts.

In addition, she says, money from the federal Technology Literacy Challenge Fund will help reduce the cost of technology integration for struggling districts.

—JESSICA L. SANDHARM
Missouri's schools are riding a wave of state-supported technology initiatives that its educators say can be traced back to the beginning of Gov. Mel Carnahan's first term in 1993.

“We just love our governor,” says Kurt Fuchs, the director of media services for the Columbia public schools. Before Carnahan's tenure, Fuchs says, “there was a drought” in educational technology.

During Carnahan's first year in office, legislators passed the Outstanding Schools Act, which included $5 million in technology-acquisition grants that districts could access provided they had a technology plan and the funds to match.

Legislators renewed the grant allocations in the years that followed, and set aside funds for competitive grants for districts with innovative proposals. By 1996, the state’s total contribution for technological improvements in its schools exceeded $850 million.

The competitive grants, especially, have infused classrooms with creative possibilities that wouldn’t otherwise be open to them, Fuchs says.

Another state initiative allows all schools free access to subscription-based electronic resources, such as a full-text periodical reference library and two online encyclopedias.

The state department of elementary and secondary education has worked to link the schools to high-speed connectivity, the powerful network offering high-speed connectivity, Thanks to a partnership program with Southwestern Bell, says the project could have a ripple effect throughout the state.

The project “could be expanded in the next couple of years,” he says. “We’re building up the infrastructure, hoping to kick off more applications.”

—JESSICA L. SANDHAGEN

MONTANA

- State Education Agency Web Site: 161.7.114.15/eps/eps.html
- State Education Agency Technology Contact: Michael Hall (406) 444-4422
- Technology Literacy Challenge Fund FY 1997: $1 million
- Technology Literacy Challenge Fund FY 1995: $2.1 million
- Selected Other Federal Resources for Technology Department of Commerce TIIAP: $1.1 million
- Number of Students: 166,909
- Student-Multimedia Computer Ratio: 19:1
- Number of Teachers: 10,110
- Technology-Trained Teachers: 18 percent

Computer Availability

Public school reports on the availability of computers to students in mathematics classes.

SOURCE: NCES, NAEP, 1996.

Montana has long had a state network for educators and a statewide system allowing for interactive teleconferencing, but only recently have lawmakers begun appropriating money that individual schools can directly use to boost their technology programs.

In a strategy that is likely unique to Montana, the legislature voted in 1995 to devote money made from the sale of timber on state lands to school technology. State officials estimate that these revenues will amount to about $9 per student in the current school year and about $17 per student next year. Montana has approximately 164,000 students.

Earlier this year, the legislature allocated a one-time sum of $12.5 million to Montana’s 471 school districts—money the districts can spend on technology, textbooks, or library and building maintenance. In return, the districts must spend an equal amount of local funds on those needs, according to the state office of public instruction.

Other states have a longer history. In 1989, the legislature created the Montana Education-
Nebraska continued from Page 70

- Technology Literacy Challenge Fund
  FY 1997: $1 million
  FY 1998: $2.1 million
- Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $1 million
  1997 Technology Innovation Grant: $3.3 million
- Number of Students: 292,121
- Number of Teachers: 20,109
- Technology-Trained Teachers: 15 percent

**Computer Availability**

Public school teachers’ reports on the availability of computers to students in mathematics classes.

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<td>Available Computers</td>
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</table>

*Source: NCES, NAEP, 1996.*

With little fanfare, some Nebraskans say, their state is becoming a national leader in school technology.

“We’ve come a long way” in a short time, observes Dean Bergman, the head of the education technology center for the state education department. For the most part, the investment hasn’t been a hard sell. Farmers have embraced computers as readily as insurance workers in Omaha or college professors in Lincoln.

That statewide recognition of the importance of technology has resulted in an impressive 13-to-1 ratio of students to multimedia computers, according to the research firm Market Data Retrieval.

And as a tool to bring educational resources to the state’s small districts, especially those in sparsely populated areas, digital technology has no equal—and no enemies.

In the past two years, Nebraska has almost doubled the number of districts with dedicated Internet connections, including voice and video transmission, according to state figures. Of the 278 Nebraska districts that include secondary schools, all but 11 are connected.

The state has boosted the number of computer-wired classrooms by about half during the same period, officials say. That leaves only a quarter of the state’s classrooms unwired.

Officials describe distance learning as a natural for the state where 1.6 million people are scattered over more than 650 districts, including some of the most sparsely populated territory in the continental United States.

An old system that included one-way satellite transmission is being replaced by one designed around the state’s 19 regional education service agencies, each of which will house a sophisticated distance-learning classroom serving a consortium of schools. Teachers in these classrooms will be able to see, hear, and interact with students elsewhere.

Four such classrooms are or will soon be in operation, with all 19 scheduled to be open for business by 2000.

While the purchase of computers has fallen mostly to local school boards, Nebraska’s K-12 Internet system has been financed primarily out of a small property-tax increase that the legislature authorized the educational service units to levy in 1993. Two years later, the legislature converted a fund for weatherization loans to a fund for school technology, adding about $1 million a year to the $3 million already being provided by the levy increase.

In the past five years, Nebraska has also garnered about $40 million for technology from outside the state, mostly in federal grants.

With much of the necessary hardware and wiring in place, leaders are turning their attention to teacher training, which they know could be improved. “I have a sense it’s all over the map in terms of the [technology] skills teachers have,” state Sen. Ardyce Bohike, who chairs the Nebraska legislature’s education committee, says.

Bohike says she expects the legislature to consider targeting money to technology staff development in the coming session.

A recent report by the University of Nebraska-Omaha’s college of education concludes that Nebraska teachers seem to be using computers more frequently in their assignments. Forty-one percent of a self-selected sample of 1,216 respondents said, for example, that they used the Internet for class assignments more than six times during the past year.

Meanwhile, Gov. Kim M. Robak is leading the charge for a Nebraska technology commission, which would devise a statewide plan for technology infrastructure.

Currently, Robak says, there is little coordination on technology between schools, universities, and state and local governments. Not only would such a plan help eliminate unnecessary duplication, it would free educators to “do what they do best”—figure out how to use technology to increase learning, she says.

Robak hopes the legislature will approve the commission next year.

**N E V A D A**

- State Education Agency Web Site: www.msn.k12.nv.us/nvdoe/
- State Education Agency Technology Contact: Frank South (702) 687-9130
- Technology Literacy Challenge Fund
  FY 1997: $1 million
  FY 1998: $2.1 million
- Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $676,680
- Number of Students: 282,131
- Student-Multimedia Computer Ratio: 28:1
- Number of Teachers: 14,723
- Technology-Trained Teachers: 15 percent

The Nevada legislature this year approved its highest-ever appropriation for education technology. But many state experts describe the funding as a “one-shot deal.”

They warn that more money may not be forthcoming unless schools can prove that it resulted in increased academic performance.

“It’s a little easier to get this passed politically than an ongoing cost,” says H. Pepper Sturm, an analyst for the legislature’s research division. “Depending on the state’s financial condition, it’s an easier sell.”

The Nevada Education Reform Act of 1997 includes several technology components, including an allocation of $27.5 million to be distributed among the state’s school districts, youth training centers, and public libraries. The money can be used for a variety of technological needs, such as the purchase and installation of hardware, software, and wiring.

The funding should help smooth some inequities, says Fred Dugger, a technology consultant for the state. “The challenge we really have is to achieve uniformity in quality of education in a state where there are such widely different backgrounds,” he says.

In addition, the legislature allocated $8.6 million for professional development, repair and maintenance, and technical support. The money will also allow the state education department to hire a technology consultant to assist districts.

The Commission on Educational Technology, which includes legislators, educators, parents, and representatives from universities and the private sector, will decide how to distribute the two allocations.

The commission is expected to develop a statewide technology plan by January 1999. That plan will be a key to future funding, Sturm says, noting that the state’s Senate majority leader has said that no more state money will be appropriated for technology until a plan is in place.
“We’ve worked so hard to get where we are now,” says Lin Forrest, a technology consultant for the state education department. Now, with the state’s growing use of technology, “there’s more awareness of what needs to be done.”

Observers say legislators have been encouraged by the success of a $2.6 million pilot program that allowed six districts to build a network to transmit data—including attendance records, demographics, student enrollment, and school reports—to the state department of education.

Officials say the network will make it easier to transfer records from schools to their district offices and the state education department. It will also enable the publication of statewide reports on student achievement, demographics, and, eventually, budgets.

The legislature approved another $12.7 million this year for the Statewide Management of Automated Records Transfer, or SMART, system. That money will expand the system to every district except Clark County, which includes Las Vegas and 62 percent of the state’s student population. Automation efforts are already under way there, and more funding to bring Clark County into the SMART system is expected in the next legislative session.

In addition, Nevada education officials are trying to find funding to continue building the Nevada School Network. A $400,000 funding request for the network was dropped in last-minute budget deliberations during this year’s session, says Doug Thunder, the assistant superintendent for administration and fiscal services. The network links all districts, providing any classroom that has a computer and a modem with Internet access.

The system runs on the same network as Nevada Net, which links the state’s universities and colleges. Using the two networks, high school students can take college courses and teachers can continue their professional development.

The state is also using other technology resources. For instance, a commission began meeting last month to decide how to distribute $1 million that the state received from the federal Technology Literacy Challenge Fund. The state has targeted poor students to benefit from the money, according to Thunder.

Among other proposals, the panel is considering a request to pay a technician to service technology needs in a consortium of rural schools, Forrest says.

In addition, the state may begin incorporating technology components into content and teaching standards.

—ANITA M. SELINE
New Hampshire continued from Page 73

Nearly half the state’s 95 districts that responded to a 1995 state education department survey did not expect to have any schools connected to the Internet by the end of this year. And, according to a survey by the research firm Quality Education Data, only 58 percent of New Hampshire’s districts had local technology plans in 1996, says Judith Fillion, the director of the state department of education’s division of program support.

Funding for technology from the state is almost nonexistent, although some money for wiring is available to schools under construction or renovation. In fact, the New Hampshire legislature pays only 7 percent of all education costs. A big reason: New Hampshire has no broad-based sales or income tax to generate a source of revenue. More than 90 percent of funding for K-12 education comes from local property taxes.

Consequently, depending on local priorities and tax bases, “some districts have everything, and some have very little,” Fillion says.

One that has a great deal is the 5,400-student Concord district. Every Concord classroom has direct Internet access, and the ratio of students to multimode computers is 7-to-1 in the district’s high school, according to technology coordinator Mark Denoncour. “The high school simply reached that status over the past three years, thanks to $2 million in bond issues and contributions from the local cable company,” Denoncour says. He also credits teachers’ “serious initiative” and administrators’ “risk-taking.”

Though most districts are not so far along, “no school district, even those most pressed for resources, is ignoring” technology, says Rep. Bill Belvin, the Republican chairman of the House education committee. “Some [programs] are rudimentary, and that’s a concern, but when [the state] makes grants for specific purposes, you usurp local prerogative,” he says. “I have great confidence in our local districts” to decide the issue for themselves.

Belvin says he sees no major funding initiative from the state headed districts’ way.

Lawmakers have taken a few steps toward advancing the cause, however. For example, they’ve created a legislative oversight committee to monitor implementation of the state’s technology plan, which was completed in March.

In addition, two years ago, the legislature authorized a distance-learning commission to study ways in which technology might benefit not only K-12 education, but health care, business, and municipal government in the state, according to D. Dickinson Henry, a businessman who chairs the commission. “We’re so rural that there is a vested interest in eliminating geographical discriminations,” Henry says.

The department of education, Fillion says, has been helping districts develop technology plans so they can raise technology funds from federal grant programs, such as the Technology Literacy Challenge Fund, and take advantage of discounts on telecommunications services that will be available next year.

The money made and saved under such programs, Fillion says, “is helpful to us as a state.”

The department last year began requiring that teachers and administrators seeking recertification earn five hours of training in technology. For the past 10 years, the state has also required that students complete a half-credit’s worth of computer education to graduate from high school. Among the points of that coursework is to make sure that students have basic skills in computer operations and can access databases.

Business also has played a role in building school technology programs. Under the New Hampshire Technology in Education Program, a group of private organizations in the state has given money to network schools, administrative offices, the state department of education, and other education agencies.

—JO ANNA NATALE

NEW JERSEY

Education Week - November 10, 1997

• State Education Agency Web Site: www.state.nj.us/education/
• State Education Agency Technology Contact: Julia Stapleton (609) 984-1644
• Technology Literacy Challenge Fund FY 1997: $3.9 million FY 1998: $0.9 million
• Selected Other Federal Resources for Technology Department of Commerce TIIAP: $1.4 million

Number of Students: 1,221,013
Student-Multimedia Computer Ratio: 18:1
Number of Teachers: 88,822
Technology-Trained Teachers: 11 percent

New Jersey is putting technology in its schools through a combined effort from its local phone company, government, and businesses.

To compensate for overcharges, the state’s local telephone provider has committed to spend $130 million on Internet access, equipment, and a high-speed network.

A new program designed by Gov. Christine Todd Whitman and her Republican colleagues in the legislature created a fund to pay for technology and to show teachers how to use it.

And businesses are providing volunteers to consult with schools and teach them how to use the new equipment.

But some educators are questioning whether these efforts are enough.

“Unfortunately, it’s still a state starting to come online,” says Raymond Farley, the superintendent of the Hunterdon Central Regional High School District in Flemington. “We have to pick up the pace.”

State officials also recognize that their work has only begun.

“We still have to raise everybody’s awareness that technology is a major part of everything we do,” says Jeffrey V. Osowski, the assistant commissioner for the division of information management services. To do that, the state is requiring each of its 594 districts to submit a plan explaining how they will use computers, the Internet, and distance learning to help students meet the goals of the state’s new common core of learning standards.

Much of the infrastructure will be paid for from a settlement with Bell Atlantic for $130 million in overcharges to the state’s residents. Under the agreement, the “baby Bell” is giving schools discounts of up to 70 percent on their phone bills, promising to wire every school with fiber optic cable by 2001, and paying for $25 million of interactive television equipment.

From the state coffers, districts will be given an extra $50 million—about $40 per pupil—in aid this year to pay for technology. The state promised the supplemental technology money will be a permanent fixture in the school-aid formula.

Even with the planning, New Jersey officials are concerned that teachers know how to use the equipment in conjunction with traditional classroom tools.

To help solve that problem, the state set aside money to establish training centers in each of the state’s 21 counties. The grants range from $175,000 to $250,000 starting this year and will drop by $50,000 each for the second and third years. After that, the centers will need to support themselves.

The sites are intended to give districts the help they need to put their plans to work.

The business community is also lending a hand. Corporations created Tech Corps New Jersey after the state’s first education summit last year.

The nonprofit’s volunteers are helping districts write their technology plans, training teachers and administrators how to use the equipment, and running a clearinghouse to help them solve problems, Donna Custard, the project’s manager, says.

The biggest weaknesses, according to the panel that reviewed the Garden State’s federal application for the federal Technology Literacy Challenge Fund, is the amount of money given to the state’s poorest areas. As a result of the complaint, the state decided to allocate half its federal money to the 11 poorest districts.

Farley, the Hunterdon superintendent, has noticed the disparity as well. His district is working closely with Asbury Park schools to train teachers, while corporations provide computers, Internet connections, and distance-learning equipment.

Hunterdon County schools, in the wealthy western section of the state, have one computer for every 2.2 students, he says. Overall, schools have seven students for every computer.

The state is “trying to offset tremendous inequities,” he says.

—DARRELL NIEFF

NEW MEXICO

Education Week - November 10, 1997

• State Education Agency Web Site: www.sde.state.nm.us/
• State Education Agency Technology Contact: Kurt Steinhaus (505) 827-6683
• Technology Literacy Challenge Fund FY 1997: $1.7 million FY 1998: $3.5 million
• Selected Other Federal Resources for Technology Department of Commerce TIIAP: $1.2 million

Number of Students: 300,522

New Mexico continued on Page 76
Equity—or the lack thereof—is one of the most pressing school technology issues in New Mexico. The way things stand in the state now, “technology is not an equalizer—it’s a deselectizer,” says Kurt Steinhaus, the technology coordinator for New Mexico’s education department.

In one school, Steinhaus says, a student reporting on China was unable to see any maps, only a World Wide Web screen where he could conduct research. In another, a student’s research project on Mexico was wired to a school for access to the Internet, according to Sandra Simons-Ailes, a 4th grade teacher in Albuquerque who serves as Network New Mexico’s president.

As a result of the grassroots efforts, 20 schools have been wired since last fall, Simons-Ailes says. With a $5,000 donation from the telecommunications company U.S. WEST, Network New Mexico hopes to wire an additional 50 to 100 schools this year, she says.

New York

New York state’s proposed “Electronic Learning Community” would involve schools, universities, and libraries. Students would have equitable access to technology, and would be able to learn in a variety of settings. Teachers would seek out advice from their colleagues, and residents would have easy access to information.

That is the vision, as set out in the New York Goals 2000 plan. But getting there will take time.

Like many states, New York has a lack of resources, a fledgling infrastructure, and a striking range of technological advancement from district to district.

In the small town of Clarkstown, for example, technology is an integral part of the district’s lesson plans, says Sandy Paben, a corporate consultant for the New York State Association of Computers and Technologies in Education.

“But there are also school districts that have done not a thing, zero, zip,” Paben says.

For several years, New York schools tapped a handful of state entitlement programs to help pay for specific educational technology expenses such as instructional hardware and wiring. In this year’s legislative session, lawmakers voted to gradually increase the hardware entitlement fund from an annual level of $10 million to $43 million by 2002.

The legislature also established an additional entitlement program that, for the first time, covers a broad array of school technology expenses, including hardware, software, and maintenance contracts.

The program is slated to begin with a $9 million pot next school year and grow to $41 million in 2002.

None of the entitlement program funding levels are guaranteed, however, rather, they are seen as spending goals. The final decisions on appropriations are left to the legislature and governor.

In establishing the entitlement program, the legislature responded to a wide-ranging educational technology plan, parts of which they adopted and parts of which they left for future action.

“In some overarching sense, the legislature embraced all facets of the plan,” says Charles DeVoe, the director of the office of technology policy, which proposed the legislative agenda for technology. Technology boosters also are eying a $2 billion bond referendum that was scheduled for a Nov. 4 vote.

Described as the largest potential infusion of capital into school buildings in state history, the referendum, if approved, would repair and replace the state’s crumbling school infrastructure.

Much of the money would be spent in rectifying age-old problems, such as replacing coal-burning furnaces in some schools or removing asbestos in others, but it also could result in more schools being wired for computers.

“One of the significant intents of this referendum is to bring New York state into the new ‘technocentric’ age, though some schools haven’t even left the 19th century,” says Steve Kaufman, the chief of staff to state Assemblyman Steve Sanders, the chairman of the Assembly education committee.

Meanwhile, New York continues to plan for technology. In particular, the state is attempting to link technology with standards for student performance.
DeVoe argues that New York is being wise by planning methodically. He cautions against the "paste-in" approach taken by some other states in which schools are provided with all the equipment they need but little training or planning to use it well.

"This [planning] helps us with what the schools really need. We may be behind the curve, but when all is said and done, we'll be ahead," he says.

Districts have until mid-November to apply for the state's Technology Literacy Challenge Fund money. The pot of $54 million for schools represents two years of grant money that have been combined. According to state guidelines, at least 25 percent of the money must be spent on professional development, a critical piece in helping New York become technologically adept.

"If you want systemic change, you've got to do it through staff development," Paben says.

In addition, 50 percent of the TLCF grant will go to the state's five largest cities, and another 10 percent will go to schools that are under state review.

—ANITA M. SELINE

N ORTH C AROLINA

- State Education Agency Web Site: www.dpi.state.nc.us/
- State Education Agency Technology Contact: Elsie Brumback (919) 715-1530
- Technology Literacy Challenge Fund FY 1997: $3.7 million
  FY 1998: 57.7 million
- Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: 52.7 million
  1997 Technology Innovation Grant: $838,584
- Number of Students: 1,199,962
  Student-Multimedia Computer Ratio: 26:1
- Number of Teachers: 73,839
  Technology-Trained Teachers: 22 percent

North Carolina has several things going for its educational technology program that many other states don't. It's made a respectable investment in this area since 1995; it requires teachers seeking recertification to get training in technology; and it obligates its high school graduates to pass a test in computer skills.

But ask North Carolina's director of instructional technology what she thinks is the state's greatest advantage, and she cites the fact that every district has

North Carolina continued on Page 78

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North Carolina continued from Page 77

developed a sound school technology plan.

The technology plans are the road maps, the vi-
sions," Blue Ridge says.

Because all 117 of North Carolina’s districts had plans by May 1996, the districts could apply early for federal grants that make such plans a require-
ment, such as the Technology Literacy Challenge Fund.

And now, Brumback says, as districts in many states scramble to develop technology plans to qualify for the upcoming federal “E-rate” telecommunications discounts, which will help defray the cost of Internet access for schools and libraries, North Carolina’s dis-

The plans come to life in part because of the
General Assembly earmarked for their development. The legislature agreed in 1994 to a proposal to pro-
vide $381 million over five years for school technol-
ogy. The money goes into the interest-bearing School Technology Trust Fund and stays there until districts are ready to claim their share.

“The advantage is people don’t feel they have to spend the money quickly or lose it,” Brumback says. “They think through their expenditures more.”

The money has helped districts equip and network their schools. According to the latest research from
the department of public instruction, the student-to-

computer ratio in North Carolina is 5-to-1, or an im-

pressive 11-to-1 counting only computers with 486
 processes or better.

In addition, 82 per-
cent of the state’s schools have access to the Internet.

Though lawmakers have

the opportunity to fund school technol-

gy—so far, only $92
 million has gone into the trust fund—they recently identified some new revenue sources. One of those—state fines and forfeitures—could bring schools $4
 million a year or more, Brumback says.

Other initiatives also set North Car-
olina apart. For exam-
ple, its students, as a condition of graduation, must take a test demonstr-
ating their technology skills when they are in 8th

grade. The test, which first-year results were due this fall, assesses such skills as word processing and the use of databases and spreadsheets, but also questions students on subjects such as the ethics of technology, Brumback says.

Another focus has been improving teachers’ knowl-
edge of technology. The department of public instruc-
tion currently is working to create a technology test that people studying to become teachers must pass before earning their teaching licenses.

“The purpose is to ensure that teachers don’t just have the basic skills, like word processing, but that they know how these skills apply to classroom in-

struction,” says Gloria Bowman, an education con-
sultant in the department’s human resources office.

In addition, starting in June 1999, practicing ed-
cators will be required to complete three to five


courses in the department’s human resources office.

construction,” says Gloria Bowman, an education con-

North Dakota was investing in computers years before many other states, and, for that reason, it has often been cited as a leader in educational tech-

ology.

Indeed, its computer-to-student ratio is one of the

lowest in the nation, at 5-to-1, according to the re-

search firm Market Data Retrieval.

That figure, however, is not as grand as it might

seem, and neither is the state’s level of commitment
to technology, school officials say.

O bsolescence has caught up with us,” says Joe

Linnertz, North Dakota’s assistant superintendent for public instruction.

North Dakota students might well have more ac-

cess to computers than students in most other states, Linnertz says, but often the equipment is old and slow.”I’d say 50 percent of our computers are

older Apples.”

And although the legislature has steadily con-

tributed money to school technology for a decade, the amounts have been modest at best, ranging from $1 million to $6 million per biennium. That funding has been awarded to the state’s 238 dis-

tricts on a competitive basis, Linnertz says.

This school year, the legislature appropriated an additional $5 million for technology to districts on a per-pupil basis. The amount works out to about

$40 per student.

Such conservative allocations are typical of North Dakota government, says Dan Pullen, who directs the Center for Innovation in Instruction, a

the software. It’s really how they put it all together for kids in the classroom.”

—JO ANNA NATALE

North Dakota

- State Education Agency Web Site:
  www.dpi.state.nd.us/
- State Education Agency Technology Contact:
  Joe Linnertz (701) 328-2261
- Technology Literacy Challenge Fund
  FY 1997: $1 million
- Selected Other Federal Resources for Technology
  Department of Commerce TSAP: $1.2 million
  1997 Technology Innovation Grant: $1 million
- Number of Students: 118,427
  Student-Multimedia Computer Ratio: 19:1
- Number of Teachers: 7,706
  Technology-Trained Teachers: 17 percent

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—JO ANNA NATALE

Ohio

- State Education Agency Web Site:
  www.ode.ohio.gov/
- State Education Agency Technology Contact:
  Sam Orth (614) 728-8324
- Technology Literacy Challenge Fund
  FY 1997: $8.6 million
  FY 1998: $16.7 million
- Selected Other Federal Resources for Technology
  Department of Commerce TSAP: $622,897
  1997 Technology Innovation Grant: $1.5 million
- Number of Students: 1,841,095
  Student-Multimedia Computer Ratio: 19:1
- Number of Teachers: 104,583
  Technology-Trained Teachers: 8 percent

Ohio continued on Page 80

continued on Page 78

Education Week • November 10, 1997
In early 1995, before Ohio's massive infusion of money into school technology, a U.S. General Accounting Office study ranked the state dead last in the number of students per computer.

Four years and $530 million later, the state intends to have wired all of Ohio's classrooms for computer use, bought one computer for every five children in grades K-4 in most schools, and trained teachers to integrate technology into their lessons.

“We were sleepy for a while, but in the last few years, technology has become an incredibly important focus,” says Tim Best, the education department's director of information, learning, and technology services. “The strength of our program is that it's not just about wires and work stations. It's about learning.”

The technological sea change in Ohio began in June 1994, when Gov. George V. Voinovich signed the SchoolNet bill, which authorized spending $50 million in bond proceeds to wire every public school classroom for the use of telephones, televisions, and personal computers. As of the start of the current school year, more than half the state's 100,000 classrooms had been wired, Best says.

SchoolNet also included $45 million in bonds to buy computers for the 153 districts with the lowest property values. About 10,700 computers have been purchased through this measure so far.

But the biggest windfall came in June 1995, when a $430 million program called SchoolNet Plus was included in the state budget. That program is buying thousands of computers for classrooms and administrative offices and helping thousands of teachers become computer literate. About 30,000 teachers participated in technology workshops this summer. All 611 districts have had to come up with technology plans and policies for education technology and the effect of technology on student achievement.

To order, send $6 (no cash, please) to:
Educational Exchange on Education Technology, 96-page report explores state plans and policies for education technology and the effect of technology on student achievement.

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norm; in fact, most schools are "teaching children as if they were still living in the American agrarian society of the 19th century," the state plan says.

"Oklahoma has 548 districts; it also has 548 levels of sophistication in technology," state Superintendent Sandra Garrett says.

The state has endorsed technology skills as a priority for students, but its financial support has run out of gas at the statehouse. This year, in the midst of a state economic boom, lawmakers boosted overall support for schools by $103 million to $1.6 billion. But they turned down the department of education's request for $62 million—or $100 per student—for school technology.

Garrett says the legislature deferred its technology investment until a planned study of school technology needs is complete.

One problem that worries some legislators is that many computers in classrooms are used ineffectively, or not at all, because teachers aren't trained in operational basics and in how to meld high-tech activities with the curriculum, according to state Sen. Darryl Roberts, who chairs the education subcommittee of the Senate appropriations committee.

In 1994, Oklahoma had the nation's lowest percentage of teachers—just 8 percent—with at least nine hours of training in educational technology, according to the U.S. Department of Education.

Legislators took steps this year toward changing that status. They gave $1 million for professional development in technology directly to public schools and $7 million from a telecommunications surcharge to the state's 29 vocational-technical schools for technology training that will be open to all teachers.

In addition, Oklahoma's teacher preparation commission, which organizes training for teachers, will sponsor technology classes.

State officials also plan to award part of the $2.3 million they received this year from the federal Technology Literacy Challenge Fund to "telementoring" projects that help qualified teachers pass along high-tech skills to colleagues.

Ironically, Oklahoma was considered one of the nation's leading technology states in the mid-1980s because of its investment in satellite technology for distance learning, an approach suited to a scattered, rural population.

But when the economy slumped later in the decade, districts cut back on spending, and most schools failed to keep up with computer hardware and software advances.

The fastest-growing tool for distance education—the Internet—has yet to reach most Oklahoma classrooms.

Only 10 percent of the state's schools have access to the Internet, and most of those have only a single, dial-up Internet connection in the library, according to a recent state survey.

The lack of on-line classrooms seems especially glaring because it limits schools' ability to take advantage of OneNet, the state's splendid telecommunications infrastructure that can transmit voice, video, and data, and provide access to electronic library materials and the Internet.

Since 1992, the state has spent nearly $14 million on expanding and upgrading OneNet, which is available to public schools, vocational-technical schools, colleges, universities, libraries, and other government agencies.

By the end of August, 129 schools had dedicated access to OneNet. Others find it too expensive—even at the discounted rates the state has set for schools and teachers—or lack the internal networks, computers, and other technology they need to use it.

OneNet officials say they hope pending telecommunications discounts from the Federal Communications Commission will help them dismantle those barriers.

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Oklahoma City, OK 73105

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November 10, 1997 - Education Week
Oregon’s schools have a fair amount of educational technology, even though the legislature has appropriated little money for it. “I wouldn’t say we are leading the nation in any way, but I think we are ahead of the curve,” says state Sen. Jeannette Hamby, whose district lies in the Portland suburbs.

Most funding for technology has come out of districts’ budgets. “The state has a very conservative fiscal outlook,” says Kathleen Heide, the technology specialist for the state department of education. “Even though the state hasn’t given a lot of direct funds [for technology], I think we do have a massive grassroots effort to think about how technology can be obtained for schools through building strong business-school partnerships, with the state facilitating some of those partnerships.”

Almost three-quarters of Oregon’s 1,212 schools are linked to the Internet with a dedicated high-speed connection. Most of the remaining schools are connected through dial-up access, according to the state education department.

Schools are receiving Internet access through a statewide effort called the Oregon Public Education Network, a nonprofit funded with money from districts’ budgets. Wendy Hawkins, the statewide manager of education relations in Oregon for Intel Corp. and a member of the Oregon Business Council, views OPEN as an organization that has to “meet minimum standards so they would not have an impact on education.”

Heide says the state department of education has emphasized technology planning. Department officials have worked closely with schools to come up with local technology plans, which are reviewed for districts by the Technology Literacy Challenge Fund money.

“We’ve seen many states proceed with big bucks who have no real movement in technology planning,” Heide says. —NEIL SOMMERFIELD

Pennsylvania

- State Education Agency Web Site: www.cas.psu.edu/pde.html
- State Education Agency Technology Contact: John Bailey (717) 787-5820
- Selected Other Federal Resources for Technology Department of Commerce TIIAP: $1.3 million 1997 Technology Innovation Grant: $2.9 million
- Number of Students: 1,807,250
- Number of Teachers: 106,400
- Student-Multimedia Computer Ratio: 21:1
- Technology-Trained Teachers: 10 percent

Computer Availability

Pennsylvania school systems’ reports on the availability of computers to students in mathematics classes.

PENNSYLVANIA

Continued from Page 81

R E C O R D S

- State Education Agency Web Site: www.edc.state.or.us/
- State Education Agency Technology Contact: James Sanner (503) 378-3310 ext. 485
- Technology Literacy Challenge Fund FY 1997: $1.0 million FY 1998: $3.8 million
- Selected Other Federal Resources for Technology Department of Commerce TIIAP: $1.3 million
- Number of Students: 637,762
- Number of Teachers: 26,757
- Technology-Trained Teachers: 15 percent

Computer Availability

Public schools teachers’ reports on the availability of computers to students in mathematics classes.

OREGON

- State Education Agency Technology Contact: James Sanner (503) 378-3310 ext. 485
- Technology Literacy Challenge Fund FY 1997: $1.0 million FY 1998: $3.8 million
- Selected Other Federal Resources for Technology Department of Commerce TIIAP: $1.3 million
- Number of Students: 637,762
- Number of Teachers: 26,757
- Technology-Trained Teachers: 15 percent

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Computer Availability

Pennsylvania school systems’ reports on the availability of computers to students in mathematics classes.
frastructure are moving too slowly. "The legislature has been supportive, but many expect the education department will do a better job to promote an integrated system as opposed to passing out money to buy equipment," says state Rep. Ronald R. Cowell, the ranking Democrat on the house education committee.

Many state officials agree that Pennsylvania has been generous in funding school technology, and Republican Gov. Tom Ridge is a strong supporter of it. But Cowell adds that districts should make technology a regular spending priority, with or without special revenues from the state. "Schools must think of technology as a regular classroom tool," he says. "I think that those investments need to come from overall school budgets."

Toward that end, district technology plans under Link to Learn are expected to show long-term funding plans for computers, networking, staff development, and infrastructure.

The idea, Bailey says, is to reduce districts' reliance on sporadic state and federal funding sources. "That's how technology becomes obsolete and irrelevant." —ROBERT C. JOHNSTON

RHODE ISLAND

• State Education Agency Web Site: instruct.ride.ri.net/ride_home_page.html
• State Education Agency Technology Contact: William Fiske (401) 277-4600 ext. 2130
• Technology Literacy Challenge Fund FY 1997: $1 million FY 1998: $2.1 million
• Number of Students: 151,181
• Number of Teachers: 10,586
• Technology-Trained Teachers: 11 percent

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www.edweek.org
Rhode Island continued from Page 83

Years before the Federal Communications Commission approved substantial amounts of money for schools to connect to the Internet, the state was striking its own deals to bring schools into the 21st century.

Thanks to a concession offered by the New England Telephone Co. while the state public utilities commission was considering regulatory reforms, Rhode Island schools and libraries can get phone lines for Internet access laid at no cost. Free high-speed digital lines have since been added to the agreement.

The deal reflects the kind of resourcefulness often found in a small state with scarce public funds for new programs. What it lacks in state dollars, Rhode Island has tried to make up for with deal-cutting, partnerships, and the generosity of private groups.

Even as schools were getting their first free phone lines, a network offering educators Internet service was being launched by a partnership of the state departments of education and library and information services, the University of Rhode Island, Brown University, and public television station WSBE-TV. Called RINet and maintained at URI, the initiative first provided basic services like e-mail accounts and Internet access. Additional features now let educators and their students publish World Wide Web pages. RINet still functions with a full-time staff of one, and volunteers carry out much of the work.

Private efforts have also given Rhode Island educators needed hardware. Since 1990, the Warwick-based Champlin Foundations have given more than $11 million to allow Rhode Island teachers to buy instructional equipment, often new computers.

Another effort, called Project SMART, seeks to ensure that such equipment is used for more than paperweights. Launched by the RINet partners in 1995 with a $750,000 National Science Foundation grant, Project SMART began by putting about 100 teachers each year through a two-week summer training program.

The hope is to inspire teachers not just to learn how to use the technology, but also to use it in creating new teaching units. To maximize its impact, Project SMART is organized so that participants later become consultants to others.

“We didn’t want this to be perceived as computer guru teaching teachers; this is teachers teaching teachers,” says William Fiske, an education technology specialist who is the state education department’s only full-time professional staff member devoted to educational technology.

Project SMART got a tremendous boost last year when the Providence-based Rhode Island Foundation gave $5 million to help expand computer training for teachers. The money allowed 314 teachers to be trained last summer, and more than 2,000 will receive training in the next two years.

To encourage Project SMART participants to continue to develop their new skills, a large part of the $5 million grant is being used to purchase additional software, file servers, routers, and related training and materials. The remaining funds will go to educational television purposes and to help ensure that every school in the state has a satellite dish and receiver.

“There has never been a question about whether we should spend the money, just how much,” says Pamela Pritchett, the senior executive for education initiatives at the state education department. “For the most part, businesses—people who run the state’s schools are—recognize that they have to have kids with technology skills coming into the workplace. They see it as like paying for electricity—it’s a part of everyday business.”

Thanks to the new funds, 74 percent of South Carolina’s 1,133 schools have high-speed access to the Internet through wide-area networks. The remaining schools are connected only through dial-up telephone lines, according to state data.

The state does not have data on how many computers there are in the classrooms. But many of them are older and not capable of being networked, according to the state’s technology plan.

A peer review team that evaluated South Carolina’s grant application to the federal Technology Literacy Challenge Fund praised the state’s technology plan, saying it demonstrated the state’s “thorough and commendable planning and forward thinking about educational technology.” It also called South Carolina’s technology infrastructure “outstanding” and commended the state’s strong efforts to elicit support from community groups and the public at large.

Under areas for improvement, the review team recommended that state officials develop a more specific timeline showing how they plan to meet the plan’s goals and benchmarks. The panel also urged them to continue revisiting local needs on a regular basis, and target funds to districts with higher percentages of poor students.

Educators say they appreciate that the state is paying for high-speed digital access lines and connectivity charges, eliminating monthly charges for an Internet service provider. Schools, in turn, are responsible for setting up a local-area network and must buy a router and any other necessary equipment.

“I don’t think there are too many states that are funding dedicated access, high-speed connections in all their schools,” says Clint Mullins, the director of technology for the Lexington 2 District in Columbia. S.C. “We have the strong support of a governor who is very proactive on technology, a supportive superintendent, and a strong private-sector partnership that has worked hard to provide a strong funding base.”

Like many other states, South Carolina has hosted a number of NetDay-style events, coordinated mostly at the local level. Even Gov. David M. Beasley has pitched in, pulling wire at W.A. Perry Middle School in Columbia.

The state also devised some creative strategies to raise additional funds. For $54, South Carolina residents can buy an education technology license plate, adorned with a bright red apple and a yellow school bus that declares “Public Education: A Great Investment.” Thirty-four dollars of the fee goes to—
While South Dakota has made some progress in bringing technology to schools, it still has "a long way to go," according to the state's technology consultant.

The main problem isn't the number of computers—the state has plenty. It's their age, says Jim Parry, the director of Technology and Innovation in Education, a nonprofit agency that has worked since 1986 under contract with the state department of education to aid technology implementation in the state's schools.

"My guess is that 75 percent of our computers are obsolete by industry standards," Parry says.

Other problems are a lack of planning—just a few districts have technology plans—and an ongoing need for teacher training. "We're still struggling with what you do [with technology] to provide communications-age teaching and learning," Parry says.

Technology efforts that have been undertaken so far are almost completely owing to state and federal grant money and to local success in raising funds, he says. The South Dakota legislature makes no regular or specific contribution to the cause, other than funding about 10 percent of Technology and Innovation in Education's work in state schools.

"South Dakota is a state with limited resources. You can't do everything for everybody," says Don Kirkegaard, the superintendent of the 540-student Britton school district, which has used grant money to further its technology program.

Some districts are looking to the upcoming federally mandated "E-rate" discount on telecommunications services as another form of financial aid. "The expense of a T-1 line is a little out of our reach right now," says Lennie Symes, the technology director for the 2,600-student Huron school district. "We're hoping with the E-rate, we'll be able to up our bandwidth. Right now, we've been adding new machines and begging down our system."

The state government, meanwhile, has embarked on an ambitious plan to wire every South Dakota school within the next 18 months. Begun last year under the leadership of Republican Gov. William Janklow, the "Wiring the Schools" program is intended to allow three-quarters of the students in each school to be on the Internet at any given time, Parry says.

The program is financed not with new legislative funds, but with federal grant dollars and carryover money from various state offices, Parry says. To keep costs down, low-security prison inmates are doing the wiring in schools—an initially controversial move that officials say has gradually won acceptance.

The two schools in the Britton district have already been wired under the program. "We ran miles and miles of computer wire, phone wire, cable TV wire. Our buildings are connected with fiber optics. Everything is the latest in technology," Kirkegaard says.

Parry praises the program, but says schools still need more help: "The weak link in the governor's program is … what you hook to the wires after the wires are in the school. The state provides no resources for buying file servers, hubs, or the necessary pieces to make the wires light up."

Parry says his agency is encouraging local communities to pitch in and buy such equipment.

—JO ANNA NATALE

Continued on Page 86
Thirty dollars per pupil per year might not seem like a great deal of money to spend on educational technology; but, over time, it adds up. In Texas, the total has grown to more than $500 million since 1992.

That investment is the largest of a number of efforts in Texas over the past decade to bring technology to the state’s 1,064 districts and 6,465 schools.

“Our strength is we’ve been in the business of thinking about and planning for technology for a long time,” says Anita Givens, the senior director of instructional technology for the Texas Education Agency. “Plus, we’ve got support from the legislature on down. This state really values the importance of technology.”

A panel that recently evaluated the state’s application for a federal technology grant agreed, calling Texas “an example of strong commitment from people across the state.”

Several initiatives currently under way serve as examples:

- The Technology Infrastructure Fund was created in 1985 in legislation requiring telecommunications companies that are seeking deregulation to contribute to school technology. Under the plan, the companies must provide discounted telecommunications services to schools and contribute $150 million a year over 10 years to efforts to wire K-12 schools and other public institutions. So far, Givens says, 200 schools have received money for wiring, with another 1,000 about to receive such funds.

- The Texas Education Network serves as an Internet provider for schools and trains teachers in helping them integrate technology into the classroom and evaluating instructional resources. “Training and content have become more important as people get more and more access to technology,” says Connie Stout, the director of TENET, housed at the University of Texas at Austin. Another of TENET’s aims: to train teachers in how to meet the state’s new curriculum standards, which include technology standards for students in kindergarten through grade 12.

Computer Use
Public school 8th graders’ reports on the frequency of computer use for mathematics.

<table>
<thead>
<tr>
<th>Percentage of Students</th>
<th>Available Computers</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>1 in a classroom</td>
<td>7</td>
</tr>
<tr>
<td>2 or more in classroom</td>
<td>21</td>
</tr>
<tr>
<td>In laboratory</td>
<td>48</td>
</tr>
<tr>
<td>On or twice a month</td>
<td>45</td>
</tr>
<tr>
<td>Once or twice a week</td>
<td>27</td>
</tr>
<tr>
<td>Everyday</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>13</td>
</tr>
<tr>
<td>1 in a classroom</td>
<td>0</td>
</tr>
<tr>
<td>2 or more in classroom</td>
<td>48</td>
</tr>
<tr>
<td>In laboratory</td>
<td>42</td>
</tr>
<tr>
<td>On or twice a month</td>
<td>25</td>
</tr>
<tr>
<td>Once or twice a week</td>
<td>21</td>
</tr>
<tr>
<td>Everyday</td>
<td>0</td>
</tr>
</tbody>
</table>

**Source:** NCSL-NAEP 1996.
Texas continued from Page 86

through 12th grade.
• Through a program called Projects for Educa-
tional Technology, the Texas Education Agency iden-
tifies exemplary technology programs statewide and
then awards grants to districts so they can share in-
formation about their projects with others.
• The Texas Center for Educational Technology, es-
stablished by the legislature in 1990 and located at
the University of North Texas at Denton, evaluates
various strategies and programs in educational tech-
nology and reports on those that do and don’t work.
• A statewide satellite network, known as T-Vista,
links districts, regional educational service centers,
and the Texas Education Agency using one-way video
and two-way audio communications. Each district has
a satellite dish allowing it to make use of the system.
• Texas’ 20 regional education service centers provide
teachers and others with a place to try out hardware
and software products before deciding to buy. The cen-
ters also provide technology training to teachers.

All the efforts statewide could benefit from some coordination, Givens says, pointing to what she says was a weakness in Texas’ overall push to get technol-
gy to schools. “We have a variety of entities in the state stimulating technology activities, but because of the diversity, we have no real coordinated statewide approach.”

Another need is for sound research on the level of technology in schools. Some of the existing research, she says, such as that from Quality Education Data, doesn’t include all districts.

“Generally speaking, the student-to-computer ratio is 10-to-1, but I can’t say we have good accurate data on what the ratio is,” Givens says.

—JO ANNA NATALE

U TAH

• State Education Agency Web Site: www.uee.k12.ut.us/
• State Education Agency Technology Contact: Vicky Dahn (801) 538-7732
• Technology Literacy Challenge Fund FY 1997: $1 million
• Selected Other Federal Resources for Technology Department of Commerce TIIAP: $769,071
• 1997 Technology Innovation Grant: $769,071
• Number of Students: 478,085
• Student-Multimedia Computer Ratio: 27:1
• Number of Teachers: 20,224
• Technology-Trained Teachers: 20 percent

Computer Availability
Public school teachers’ reports on the availability of computers to students in mathematics classes.

<table>
<thead>
<tr>
<th>Percentage of Students</th>
<th>Grade I</th>
<th>Grade II</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>1-5</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>6-10</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>11-20</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>21-50</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>More than 50</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

SOURCE: NELS, NAEP 1996.

Utah has put educational technology high on its list of priorities.
The legislature’s support dates to 1990, when it passed the Educational Technology Initiative. That measure alone has resulted in $87 million for school technology.

“Though the money never seems like quite enough, we know we’re very fortunate,” says Vicky Dahn, the coordinator of instructional technology for the state office of education. “We only have 480,000 students K-12, and that really puts [the amount of funding] into perspective.”

One reason for the state’s support: Utah is a rural state, and people see technology as a way to help even out educational op-
portunities for students in remote areas, Dahn says.

Another reason is Utah’s growing sta-
tus as a technology hub. The state is home to more than 1,500 high-tech firms, and many parents of school-age children build technology-related jobs. “It really helps their understanding of the issue,” Dahn says.

Schools have bene-
fit from the firms’ presence in other ways, too. Many schools have formed partnerships with the compa-
nies, which have donated hardware, software, human resources, and money, says Republican state Sen. David Steele.

The donations have provided a “strong infusion of technology in schools,” says Steele, the director of instructional technology for the Davis school dis-

Although the legislature has given financial sup-
port to Utah’s school technology every year since 1990, the money was allocated through supplemental fund-
ing until 1993. Beginning that year, however, law-
makers made technology a line item in the state budget, Dahn says.

“The legislature has gone from ‘we’ll throw some money at you, and once you know the amount, you can decide what to do with it,’ to long-term line-
item funding of educational technology,” she says. That funding pays for computer maintenance and replacement.

Other funds have supported other efforts. In 1994, $5 million was appropriated to help link schools to the Internet. Today, all of Utah’s sec-
dary schools have Internet access, with T-1 lines or better, Dahn says. As part of the deal, districts are responsible for connecting their elementary schools; so far, she says, about 70 percent of the ele-
mentary schools have been connected.

Another technology initiative funded by the state legislative is EdNet, Utah’s interactive video sys-

Many schools in outlying areas rely on the system to round out curricula that might lack, for instance, foreign language or advanced math courses.

About 9,000 students use EdNet, taking 228 courses from remote locations, according to Edward Ridge, the system’s director. Up to half the sys-

The plan makes no attempt to require specific ac-

Vermont has had a state technology plan in place since 1996, but it’s a plan without a clear leader. The state department of education has no design-
ated office of technology and no technology direc-
tor at the state level.

As a result, Vermont has “made less progress than … would have [been] expected” in its technol-
gy program, according to a panel that reviewed the state’s application for a federal Technology Lat-
eracy Challenge Fund grant. In its critique last March, the group said Vermont needs state-level people to “concentrate exclusively on coordination of technology planning and implementation across the state.”

Vermont’s plan, developed by consultants, makes several general recommendations. Among them: that students receive “adequate access” to technol-

The plan makes no attempt to require specific ac-

In Vermont, it’s almost impossible to dictate Vermont continued on Page 90

Technology Counts

V E R M O N T

• State Education Agency Web Site: www.state.vt.us/educ/
• State Education Agency Technology Contact: Robert Dunn (802) 828-3111
• Technology Literacy Challenge Fund FY 1997: $1 million
• Selected Other Federal Resources for Technology Department of Commerce TIIAP: $45,027
• Technology Innovation Grant: $533,383
• Number of Students: 106,607
• Student-Multimedia Computer Ratio: 25:1
• Number of Teachers: 7,787
• Technology-Trained Teachers: 18 percent

Computer Availability
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Vermont’s plan, developed by consultants, makes several general recommendations. Among them: that students receive “adequate access” to technol-
ygy resources, that teachers receive training in how to use technology to strengthen instruction, and that state and local governments make funding for technology a priority.

The plan makes no attempt to require specific ac-

In Vermont, it’s almost impossible to dictate

—JO ANNA NATALE
Vermont continued from Page 88

anything," says Craig Lyndes, the data-processing manager at Champlain Valley Union High School in Hinesburg. "If the state [officials] said, 'You have to have a computer for every 4.5 students,' they'd have their heads handed back on a platter."

Still, Vermont's technology program has edged forward. According to the research firm Quality Education Data, 94 percent of schools and 25 percent of classrooms in the state had access to the Internet in 1996.

When considering all types of computers, the student-to-computer ratio is 7-to-1, when taking into account computers that are 386 megahertz or higher, the ratio is 10-to-1, according to QED.

At the state level, various initiatives are under way to improve students' technological capabilities. Most recently, the state has contracted with the Vermont Institute for Science, Math, and Technology to help districts develop technology plans. To that end, the agency is running regional training centers, paid for with $100,000 of the $1 million that Vermont received in Title I money in fiscal 1997, says Frank Watson, the institute's executive director.

Once districts have approved technology plans in place, Watson says, they will be eligible to apply for the "E-rate," a federally prescribed discount on telecommunications services.

Other initiatives in the works: At Gov. Howard Dean's urging, the legislature has appropriated $750,000 over three years to help wire schools for local-area networks, says Patricia Urban, the chief information officer for Vermont's state government. Urban says that he hopes his commission, which was formed this summer, will push for legislation that will continue to modernize the state's fleet of technological capabilities. Urban says, "We are desperately trying to play catch-up."

With a thriving local technology industry and an ambitious educational technology plan, Virginia has built a solid infrastructure in which every school in the state is wired to the Internet. But when it comes to making computers handy learning devices for students in the classroom, the Old Dominion is "a bit slow at the switch," says Del. Kenneth R. Plum, the chairman of Virginia's Joint Commission on Technology and Science.

"Two-thirds of the gross state product growth can be attributed to high-tech firms, but the state is lagging in its use of technology in education," Plum says. "We are desperately trying to play catch-up."

The first goal of Virginia's six-year technology plan is to develop the state's infrastructure. Since the state board adopted the plan in 1994, the legislature has set aside $788,381 million of the $100,000 of the $1 million that Vermont received in Title I money in fiscal 1997, says Frank Watson, the institute's executive director.

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The first goal of Virginia's six-year technology plan is to develop the state's infrastructure. Since the state board adopted the plan in 1994, the legislature has set aside $200 million to assist schools in upgrading and replacing equipment and to establish and develop school and districtwide network connections. And in the 1996-98 budget cycle, state leaders approved a $20 million expenditure for calculators for math and science classes.

As a result of this public investment, the ratio of students to computers in Virginia schools is currently 9-to-1, down from 15-to-1 in 1994, education department figures show. State leaders say they hope to reach their goal of a 5-to-1 ratio in the next few years.

Noting that half the computers in Virginia schools are outdated, the state faces the large task of trying to modernize its infrastructure at the same time, according to Lan Neugent, Virginia's acting assistant superintendent for technology.

In addition to multiplying hardware and networking schools, Virginia's plan also calls for any technological advances to complement the state's new, rigorous standards of learning. By the end of 5th grade, students must "demonstrate a basic understanding of computer theory including bits, bytes and binary," according to state standards that will be phased in over the next few years.

A few districts have already constructed state-of-the-art technology systems to meet these and other educational goals. For example, schools in Fairfax County, an affluent suburb of Washington, had a $34 million technology budget in fiscal 1997 and a 4-to-1 ratio of students to computers. Some urban and rural school systems have been experimenting with distance learning with the help of local telecommunications companies that have offered districts a cut rate on high-speed fiber-optic cable systems. But on the whole, districts haven't been given much guidance or how to use technology in innovative ways in their classrooms. State officials, one expert says, have required schools to arrive at a destination without giving them a map.

"It's like saying, 'Use the tools that you have,' but not telling them how. And that's a problem," says Jeff Sun, an educational technology consultant with the federally funded Appalachia Educational Laboratory.

In addition, a greater investment needs to be made in personnel to manage these growing technology systems, Sun says. While a large district like Fairfax has several systemwide managers, 23 school-based teacher trainers, and weekly seminars on the latest software, smaller districts may have only one person to handle a range of needs.

Virginia education leaders have recently taken some actions to address teacher training. The state plans to use 70 percent of the $2.8 million it won through the federal Technology Literacy Challenge Fund in fiscal 1997 to bolster teacher preparedness. And last spring, the state board proposed making technology training a requirement for teacher certification in Virginia.

But on the whole, districts haven't been given much guidance on how to use technology in innovative ways in their classrooms. State officials, one expert says, have required schools to arrive at a destination without giving them a map. "That will affect things dramatically," says Jeff Sun, an educational technology consultant with the federally funded Appalachia Educational Laboratory.

W A S H I N G T O N

• State Education Agency Web Site: www.ssei.wednet.edu/
• State Education Agency Technology Contact:
  Cathy Parise (306) 586-3894
• Technology Literacy Challenge Fund
  FY 1997: $2.2 million
  FY 1998: $6.1 million
• Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $788,381
  1997 Technology Innovation Grant: $2.6 million
  Number of Teachers: 971,903
  Student-Multimedia Computer Ratio: 23:1
• Number of Teachers: 47,479
  Technology-Trained Teachers: 26 percent

SOURCE: NCES, NAEP, 1996.

Computer Availability

Public school sixth graders' reports on the availability of computers to students in mathematics classes

Number of Teachers: 80,896
Technology-Trained Teachers: 14 percent

Computer Use

Public school sixth graders' reports on the frequency of computer use for mathematics.

Percentage of Students

SOURCE: NCES, NAEP, 1996.

Computer Use

Public school sixth graders' reports on the frequency of computer use for mathematics.

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Percentage of Students

SOURCE: NCES, NAEP, 1996.

Computer Use

Public school sixth graders' reports on the frequency of computer use for mathematics.

Percentage of Students

SOURCE: NCES, NAEP, 1996.
In Washington state, home to the corporate headquarters of Boeing Co. and Microsoft Corp., education officials and lawmakers have worked to keep pace with the state’s technologically savvy residents.

Their efforts have put Washington schools "ahead of the curve" when it comes to providing students access to technology, says Anne Hately, the Washington liaison for the Northwest Regional Technology in Education Consortium, a federally supported program that provides technological support to six states.

"I think the presence of Boeing and Microsoft has helped," adds Dennis Small, an education telecommunications supervisor at the office of the superintendent of public instruction. "It’s brought in a population of parents who are aware of high-tech possibilities."

Almost all of Washington’s districts have achieved some type of Internet connectivity through local and regional efforts. Now, legislators and educators are installing a statewide computer network designed to provide better, high-speed Internet connections to every district and postsecondary institution.

The network will also give schools the capacity to hold two-way video telephone conversations.

Established by legislation in 1995, the K-20 network has already begun to serve the state’s higher education institutions and its nine educational service centers, regional offices that provide administrative, instructional, and technical support to districts. In September, the state began wiring the districts themselves.

Chris Gray, the coordinator of instructional technology for the 24,000-student Lake Washington school district, in the Puget Sound region, says the network will offer much better service.

Lake Washington has accessed the Internet through its regional network for some time, says Gray, but the connections are not as stable as many would like.

Washington continued on Page 92
Washington continued from Page 91

The teachers want to teach what they have planned, and they get frustrated when the networks are down," Gray says. "The state's biggest contribution right now is the vision of getting high-speed connections in each classroom."

In addition, Washington legislators have funded competitive grants for classroom integration of computer technology for the past three years. This year, legislators allocated $15.5 million, the largest commitment to date.

"The philosophy is to have access that is fair and equitable," says Forrest Fisher, the director of the technology support center that serves districts in southern Washington. "Some districts have chosen to allocate their resources to technology and some have not, but they have had an equal opportunity."

While state and district officials have worked to make the tools themselves accessible to schools, teacher training has "fallen through the cracks," Small says. "We get very limited funds for staff development from the state," she says.

"We are a small district; we don't have a lot of discretionary income," says John Hager, the superintendent of the Barbour County schools in Philippi, a rural area with high unemployment. "There's no way we would be where we are today without state help in the area of technology."

When West Virginia launched into technology planning in 1989, the governor, legislators, and members of an advisory committee on technology realized that the state didn't have the money to outfit all its schools at once with new technology. So they took the unusual approach of starting with kindergarten classes and moving on up through the grades one year at a time.

"It seemed like a slower method, because you had to share the resources with all districts," says Ray Woolsey, the superintendent of the Logan County schools. "But it was more equitable to do it this way."

The state implemented a "turnkey solution," hiring two contractors—Justen's Learning Corp. and IBM—to provide teacher training, hardware, software, and technical support all at once.

Although the state has provided a lot of technology, it doesn't have up-to-date data on how much of it is in the schools. "All we know is what we're purchasing," says Brenda Williams, the executive director of the education department's technology office. "State contractors are not the only mechanism to purchase those computers."

Fortunately, West Virginians have supported technology spending, says state Sen. Lloyd Jackson, even though "there's not a lot of good research out there to show how those programs have worked, because they're so new."

Lawmakers have believed that "future jobs depend on people having technology skills," says Jackson, a Democrat who chairs the state Senate education committee.

Since 1989, the legislature has consistently appropriated funds for technology, almost entirely from lottery money. From fiscal 1995 to fiscal 1997, the legislature appropriated $52 million. For fiscal 1998, the legislature has appropriated $25 million.

The state school board approved the state's technology plan in October 1996. The legislature doesn't have to approve the plan, which is currently being updated, but education department staff must give monthly reports on school technology to the Senate education committee. "The legislature has had a close eye on things," Jackson says. "We set the parameters for the contractors."

School technology is a relatively new subject in Wisconsin—and, many would argue, an overdue one. According to the state's own technology plan, completed in December 1996, Wisconsin schools "lack the technology resources necessary to ensure an equitable educational opportunity for all Wisconsin students that will adequately prepare them for the 21st century."

Among the plan’s assessments:

- Most districts lack comprehensive technology plans.
- State-imposed revenue caps keep local budgets

**W I S C O N S I N**

- State Education Agency Web Site: www.dpi.state.wi.us
- State Education Agency Technology Contact: Neah Lohr (608) 266-3856
- Technology Literacy Challenge Fund FY 1997: $3.4 million FY 1998: $6.8 million
- Selected Other Federal Resources for Technology Department of Commerce TIIAP: $303,119
- Number of Students: 884,738
- Student-MultiMedia Computer Ratio: 19:1
- Number of Teachers: 55,296
- Technology-Trained Teachers: 16 percent

**Computer Availability**

Public school teachers' reports on the availability of computers to students in mathematics classes.

SOURCE: NCES, NAEP, 1996.

Number of Students:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 4</td>
<td>70</td>
</tr>
<tr>
<td>Grade 5</td>
<td>48</td>
</tr>
<tr>
<td>Grade 6</td>
<td>23</td>
</tr>
<tr>
<td>Grade 7</td>
<td>17</td>
</tr>
<tr>
<td>Grade 8</td>
<td>2</td>
</tr>
</tbody>
</table>

Percentage of Students:

- Grade 4: 70%
- Grade 5: 66%
- Grade 6: 51%
- Grade 7: 43%
- Grade 8: 48%

Number of Teachers: 20,642

Percentage of Teachers: 28:1

Technology-Trained Teachers: 17 percent
Wisconsin continued from Page 92

from contributing much to school technology.

• Districts range greatly in how much they spend on technology.
• Just 10 percent of the state's districts have full-time technology coordinators.
• Teacher training in technology varies widely among districts.

A drive to improve school technology, however, is mounting at the state level. With the completion of its technology plan, Wisconsin has in hand a roadmap for school technology that a federal review panel called “comprehensive and forward-looking.” Among other measures, the plan calls for requiring every district to have its own technology plan, for giving every classroom access to equipment to support video, voice, and data networks, and for making technology training a condition of teacher recertification.

The plan also calls for a 5-to-1 ratio of students to modern computers. Last year, the ratio was 8-to-1, according to a study conducted by the Wisconsin Association of District Administrators and the Wisconsin Education Association Council, but the count included old computers as well as modern ones.

Funding to help make the plan’s goals a reality is looming. In the last biennium, the legislature set aside its first contribution to school technology: $40 million, available to districts through a competitive grant program.

Schools will get a far more significant boost in the 1997-99 biennium, however, under a law passed in October that stems from a proposal put forth by Republican Gov. Tommy G. Thompson. Known as Technology Education Achievement in Wyoming, or TEACH Wyoming, the law will provide block grants to districts totaling $82 million over two years. Every district will get a base sum to spend on technology, along with an additional amount based on need.

Districts can spend the money where they think it will best serve their technology program, says Robert Cramer, an analyst in the state’s department of administration.

“There’s a wide spectrum of technology in place in Wisconsin schools,” Cramer says.

In addition, TEACH Wisconsin will provide $100 million, over two years, in loans to districts for use in upgrading their electrical wiring and installing computer networks. The districts have 10 years to repay the money, but only need to repay half the amount they borrowed, Cramer says.

Yet another provision guarantees every public school district and private school at least one high-speed data or video link at a cost of no more than $250 a month. Districts will realize significant savings under such an arrangement—up to $1,000 a month for a data link and up to $2,000 a month for a video link, Cramer says.

A final piece of the legislation gives a total of $6 million over two years to a competitive grant program for professional development and technical assistance. That program will be open to regional education agencies and to districts that group together to apply for the funds.

Teacher training in technology is Wisconsin’s greatest need, according to Neah Lohr, the team leader in the instruction, media, and technology office of the department of public instruction.

“One weakness—there’s no question—is the proper use and integration of technology in the classroom,” Lohr says. Wisconsin awarded the $3.5 million it received this year from the federal Technology Literacy Challenge Fund money to districts seeking money to boost teacher training. —JO ANNA NATALE

Wyoming

• State Education Agency Web Site: www.k12 wy us
• State Education Agency Technology Contact: Linda Carter (307) 777-8252
• Technology Literacy Challenge Fund
  FY 1997: $1 million
  FY 1998: $2.1 million
• Selected Other Federal Resources for Technology
  Department of Commerce TIIAP: $86,463
• Number of Students: 98,777
• Student-Multimedia Computer Ratio: 13:1
• Number of Teachers: 8,700
• Technology-Trained Teachers: 20 percent

Wyoming districts are in the unenviable position of never having yet received a dime in state funding for school technology.

In February, however, the legislature signaled a change in intent by beginning the bidding process for a telecommunications delivery system that would bring data and voice connectivity to all state schools by 1999. And in June, lawmakers passed a bill that would give $40 million to districts to develop local and wide-area networks and to train teachers. That money, however, has yet to be allocated.

Part of the reason for lagging financial support to date is that the state’s funding system is in flux. The Wyoming Supreme Court in 1995 declared the state’s way of paying for its schools unconstitutional; the process has been tied up in court ever since.

“It’s a quagmire,” says Mark Antrim, the director for information and communications services for the Natrona County schools in Casper.

Districts, consequently, have had to rely on their own resources to acquire technology, using bonds, operating budgets, and money from federal grant programs such as Goals 2000 and the Technology Literacy Challenge Fund.

One key area where districts have spent the money is on computers.

The research firm Market Data Retrieval places Wyoming’s student-to-computer ratio at 4-to-1, one of the nation’s best. But Linda Carter, the program director for technology in education at the state department of education, notes that Wyoming has many old computers that can’t be networked.

The state technology plan, completed last spring, aims for a ratio of four students per multimedia computer. Carter says. The current ratio is 18-to-1, according to state data.

“If state funding comes through, that should happen by the year 2000,” she says.

Other goals in the state technology plan include bringing interactive two-way video capability to each high school. The state currently has a video system that reaches 27 communities, but its primary use is for higher education and for meetings, not K-12 education, Carter says.

While additional funding for technology in Wyoming is critical to moving schools forward, Carter says, she also encourages districts to take other steps that do not require much money. Such strategies include forming partnerships with businesses, colleges, and libraries and drafting detailed technology plans. All 48 districts have technology plans, she says, but they vary in scope.

One district that has helped itself is Natrona County. “In two years, we’ve gone from not being connected at all to being fully connected,” Antrim says.

He says the effort is largely the result of students, teachers, and administrators volunteering to wire schools themselves and a $5 million bond issue earmarked for technology. As of this month, Antrim says, every district classroom, as well as every administrative office in the 12,600-student district, will have Internet access.

“To me, it’s a seminal step,” he says. “Now that [the infrastructure is in place], technology has a lot of meaning to people.” —JO ANNA NATALE

Education Week • November 10, 1997

Computer Availability

Public school teachers’ reports on the availability of computers to students in mathematics classes

Number of Teachers:

Selected Other Federal Resources for Technology

Department of Commerce TIIAP: $86,463
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- standard-setting initiatives in all 50 states;
- the experiences of one school district in writing its own standards.

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- the debate over Goals 2000.

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