

summary

The new global economy affects the lives of all Americans in many ways. It has transformed the workplace with a growing number of new and different jobs that require increased proficiency with technology and other demanding job skills. Tomorrow's successful workers will require a constantly changing set of skills, with technology skills at the forefront. Such rapid advancements in technology will require a workforce committed to lifelong learning, and the foundation for that commitment can be built in the nation's schools. States must work to prepare students—and the teachers who teach them—to understand and apply the benefits technology offers by requiring professional development for teachers in technology, sustaining essential funding for education technology, and ensuring the effective use of computers in the classroom.

implications of the new economy for education

Since April 1991, the U.S. economy has enjoyed its longest-ever peacetime expansion, characterized by low unemployment and the lowest rate of inflation in thirty years. Productivity is up, the stock market is booming, and economic forecasts predict no immediate end to the current good times. Yet, in the midst of this economic prosperity, there exists a growing wage gap between low-income workers and higher-income workers and a growing skill gap between those who have computer and telecommunication skills and those who do not. In the current economic environment, the number of jobs that require high-technology skills is rapidly expanding, while the availability of low-skill jobs is decreasing.

This situation will only accelerate as the twentieth century—and the industrial economy that fueled it—draws to a close. Manufacturing industries in the United States already have experienced a significant decline because of the falling prices of manufactured goods and competition from Asia and other developing countries. Based on current trends, the economy's manufacturing sector will continue to decline as the U.S. economy shifts toward knowledge-based industries and services, information technology businesses, and telecommunications.

To succeed in the nation's changing economy, workers must be well versed in computers and other high-technology systems. In addition, workers must be able to adapt to changing work structures and be willing to perform a wide range of tasks. Workers today and tomorrow can expect to change jobs several times during their careers. As a result, workers will have to constantly upgrade their skills and expand their knowledge base. They will need to be lifelong learners.

The ability of employees and job seekers to thrive in the changing economy will depend, in large part, on the knowledge and skills they acquire in school. A strong base of reading, writing, numeracy, and language skills is critical for success in the workplace, and students must emerge from school firmly grounded in these subjects. Ten years ago, this may have been enough to secure a high-paying job. Today, employers are looking for workers who display a high level of competence with computers and telecommunications and who possess the ability to quickly adapt to new technologies and new ways of working.

Children in schools today are the future workforce, and they deserve the opportunity to succeed in their lives. Schools must help prepare students not only by giving them the skills they need to flourish, but also by blending technology into this learning process.

governors' commitment to improving america's students and schools

Governors across the nation have shown a tremendous commitment to improving the quality of education in their states. The implementation of high standards and assessments for all students

has moved education reform to new and exciting levels. Many Governors' initiatives in the past five years have incorporated technology enhancements and strengthened teacher training.

Under the leadership of Governor Don Sundquist, Tennessee has substantially expanded its education technology capacity by increasing the number of computers connected to the Internet by 50,000 in the last year, bringing the total to more than 100,000 and giving all 900,000 students and 50,000 teachers in Tennessee the opportunity to use them. The Tennessee Department of Education used its Technology Literacy Grant to challenge K-12 teachers to integrate technology into their teaching using performance-based professional development activities. Preliminary results show gains of 40 percent to 75 percent in teachers' technology skills.

Colorado used its Technology Literacy Challenge Fund Grant from the U.S. Department of Education to award infrastructure grants to public and private schools with high student-to-computer ratios. Thirty-one grants of \$10,000 each were awarded to nineteen elementary schools, nine middle schools, and three high schools.

Wisconsin Governor Tommy G. Thompson's initiative, Technology for Educational Achievement in Wisconsin (TEACHWI), is providing public school districts with more than \$185 million in loans, grants, and subsidies for education technology during the next two years. The funds can be used for wiring, software, hardware, data and video links, teacher training, and other purposes related to education technology, except salaries or benefits for school district employees.

To ensure that the state's education institutions work together to coordinate access to information technology rather than duplicate existing services, Washington implemented the high-speed K-20 Network, giving schools across the state an unprecedented opportunity to connect students and educators with online resources. The video-conferencing component of K-20 will be the primary medium for professional development for educators, enabling the state to provide staff development programs in a cost-effective manner and offer teachers the convenience of accessing conferences from a remote location.

education technology: the key to standards-based reform

Since the beginning of the 1980s, many states have embarked on initiatives to reform their education system. They are focusing on establishing a standards-based education system, raising test scores, and improving student performance.

Technology complements the goals of school reformers by helping educators and students create new ways of teaching and learning in and out of the classroom. When used effectively, technology can improve student performance and help prepare students for the digital economy they will enter as adults. Because technology and school reform are so closely intertwined, it is important that legislators include technology as an integral part of their state's reform initiatives; technology initiatives should not be proposed independent of other reform initiatives.

For example, Texas has student standards pertaining to technology, one that is a stand-alone technology standard and one that is integrated into other subject areas. To graduate, students need one credit from a specified selection of technology courses.

skepticism about state education technology investments

Skeptics of states' investments in education technology offer several criticisms. Although the debate remains lively, states are addressing these issues while achieving tremendous accomplishments in incorporating technology into public education. Critics have raised the following issues.

- *Technology in the classroom cannot be viewed as a panacea for all of public schools' ills.* Nobody believes that technology in the classroom is the answer to the problems in the public school system. Technology alone cannot improve weak schools. However, if implemented in a meaningful way, technology can enhance children's education. For example, a 1999 study of West Virginia's Basic Skills and Computer Education program concluded that the more students participated in the program, the more their test scores rose on the state's standardized assessment.
- *The educational software used in today's classrooms is not hands-on and is inhibiting children's imagination.* Studies on the use of technology for classroom instruction point to increases in student achievement levels. Students become better problemsolvers and communicators. One study documented marked student improvement in math and science when computers were used to provide concrete visual support for abstract concepts.¹ Other research shows that the quality of student writing improves significantly when students use a computer writing tool.² More recently, 219 research studies from 1990 to 1997 were reviewed to evaluate the effect of technology on learning and found that students in technology-rich schools showed increased achievement in preschool through higher education for both regular and special needs children.³
- *The Internet is still too dangerous for children.* States have had great success in protecting their students from Internet misuse. For example, Tennessee's Internet provider protects all students from inappropriate material through its statewide filtering system.

education technology: the challenges ahead

building a better teaching force

Of course, simply placing a computer in every classroom—or even on every desk—will not improve education. Absent well-trained teachers who can use technology as an integral part of teaching and learning, computers will be nothing more than high-technology gadgetry. States are faced with the challenge of building the professional competency of their teachers and ensuring that they know how to use the new technology and how to integrate it into instruction at all grade levels.

Many states already are addressing the issue of professional competency. Tennessee's 21st Century Training Program provides instructional technology training and support for educators by offering seminars and workshops at three instructional technology centers, located in Lexington, Nashville, and Knoxville. At each center, educators can obtain basic computer training, learn new ways to integrate technology into the classroom, study Internet and other online resources, and access other learning opportunities.

preparing teachers for meaningful technology use

Technology will not be effective in the hands of poorly prepared educators. Teachers need to be technologically literate and ready to integrate computers and other forms of multimedia and telecommunications technology into their teaching before they step into a classroom. Currently, only 28 percent of teaching colleges require students to learn how to incorporate various technologies into class instruction, according to a recent report by EDvancenet, *The Leader's Guide to Education Technology*, at <<http://www.edvancenet.org>>. Teaching colleges and other teacher training institutes must make the use of education technology part of their curriculum and instruct future educators in the best methods and practices of using that technology in the classroom. In addition, states should continue to develop technology requirements for new teachers.

According to a survey conducted by *Education Week*, thirty-eight states require teaching candidates and teacher preparation programs to meet certain education technology requirements. North Carolina and Vermont both require new teachers to present a portfolio of their technological skills that demonstrates their proficiency.

promoting ongoing professional development

Not only do teachers need technology training before they step into a classroom, but states and school districts also need to think carefully about ongoing professional development to ensure that investments in technology result in improvements in learning. In a recent study conducted for the Educational Testing Service, at <<http://www.ets.org/research>>, Harold Wenglinsky found that the amount of technology training a teacher receives affects the way he or she uses technology, which influences how and what students learn and their achievement. Children whose teachers used computer applications that support higher-order thinking performed better than students whose teachers used computers mainly for educational games. The Technology in the Classroom program in Mississippi places exemplary technology-using teachers as mentors—one in every school. These teachers receive more than 140 hours of training from the Mississippi Department of Education on topics that include the integration of technology into the curriculum, the use of technology tools, and the application of leadership skills.

ensuring the effective use of computers in the classroom

Students who attend schools in which there is little technology or where existing technologies are used ineffectively will leave school poorly prepared for higher education or employment. States must have accountability measures for assessing and reporting progress to demonstrate that technology belongs in the schools and is working. Are students in technology-rich schools able to demonstrate fluency in technology literacy, are they developing higher-order skills by using computers, and are they making progress in learning technology over time?

According to a survey conducted by the Milken Exchange on Education Technology, thirty-six states have student standards for technology. As of 1998, six states assess student achievement on technology standards on a statewide basis. The recently developed North Carolina Test of Computer Skills is administered to eighth graders as part of the state's formal assessment program. Passing the test is a high school graduation requirement; if eighth graders fail to pass the test, they must retake the test until they pass it.

sustaining essential financial support

The need to maintain and upgrade equipment and software and to control the cost of teacher training is absolutely essential and cannot be ignored. Seymour Papert of the Massachusetts Institute of Technology and Gaston Caperton, former Governor of West Virginia, believe that providing every student with a suitably powerful computer would increase the cost of education in the United States by less than 2 percent. However, technology costs go beyond one-time hardware and software expenditures. States and school districts must factor in ongoing costs for facilities upgrading, teacher training, telecommunication access, and maintenance and repair.

States are using creative strategies to fund education technology. For example, Iowa uses its ownership of the Iowa Communications Network to provide services to schools at a discounted rate. It sells other telecommunications services to state agencies to pay for the services for schools. Indiana provides \$5 million per year in low-interest (1 percent) loans to school districts for projects related to instructional technology. In addition, the state uses gaming revenues to fund the

Technology Plan Grant Program, which provides approximately \$20 million annually in grants for the implementation of district technology plans.

next steps for states

It is essential for Governors to ensure that technology in schools motivates students to be more interested in learning. The effectiveness of technology in education systems depends on this. School districts and schools must be held accountable when incorporating new instruments of technology into teaching and learning. Governors should use their relationships with other policymakers at the state and local levels to ensure that student progress is continuously measured. It is important to look at the impact that technology is having on students and their achievement.

Accountability is one element of the significant effort to merge technology into schools. Along with measuring student learning, states need to have technology standards. Governors have had and continue to have a crucial role to play as leaders of standards-based education reform, promoting a vision of the benefits of technology and what it takes to integrate those benefits into state standards. States are working to include technology competency into content and performance standards, but there is much more to be accomplished. Technology standards should enable students to learn how to seek and find information, analyze and evaluate data, solve problems, and communicate more effectively.

Governors must also help guarantee the ongoing planning and financial support for incorporating current technology into teacher preparation and professional development. Simply purchasing computers for the classroom and connecting them to a network will fail to meet student needs. Only through a combination of rigorous technology standards, high-quality educators, and states' unwavering funding commitments will education technology change the way America learns.

endnotes

1. M.P. Alexander, "The Effective Use of Computers and Graphing Calculators in College Algebra," *Dissertation Abstracts International*, 54-06-A (1993).
2. M. Zeller-mayer, G. Salomon, T. Globerson, and H. Givon, "Enhancing Writing-Related Medicognition through a Computerized Writing Partner," *American Educational Research Journal*, vol. 28, no. 2 (1991): 373-91.
3. J. Sivin-Kachala, *Report on the Effectiveness of Technology in Schools, 1990-1997* (Washington, D.C.: Software Publisher's Association, 1998).