

The
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EDUCATIONAL TECHNOLOGY

What Is Educational Technology?

School districts across the nation are on the front lines of a billion-dollar technology revolution. But what guidelines does the research offer for making the most of those dollars? This edition of the *Balanced View* takes a close look at the issues surrounding the growing acquisition and use of technology in our schools. We begin with a historical overview of computer-based applications.

Among the earliest applications of computer technology in education were *computer-assisted instruction* (CAI) systems, designed to automate certain forms of tutorial learning. Introduced in the 1960s, CAI systems delivered basic skills instruction through a drill and practice format. Modern versions of CAI systems, known as *integrated learning systems*, are found in about 30% of the nation's schools. These systems offer a comprehensive curriculum package with extensive instructional management features.

Computer technology proliferated in schools during the 1980s with the advent of microcomputers. The predominant instructional

application of the microcomputer was (and still is) drill and practice—a use consistent with traditional methods of school instruction. In recent years, however, computer applications have extended beyond “drill and skill,” in response to changes in educational thinking.

Inspired by the research of cognitive scientists, many educators have begun to favor a pedagogic model that places learning largely in the hands of students. Under this “constructivist” model, students initiate and control their own learning, learn to think critically and analytically, work collaboratively, and engage in a variety of “authentic” learning tasks. In schools that practice the new pedagogy, technology has been used in a raft of innovative ways:

- to simulate concepts, environments, or systems;
- for word processing or desktop publishing;
- as a numerical spreadsheet;
- to manipulate or graphically display data;
- as a medium for local and distant communication;
- as a vehicle for presenting interactive exhibits and demonstrations; and,

- as an information retrieval system to extract data from the Internet, on-line databases, and/or CD-ROM media.

With the availability of “e-rate” discounts, moreover, experts expect schools to take far greater advantage of these technology applications. Although the primary use of technology remains drill and practice, linking computers with the new pedagogy may ultimately offer the most fertile ground for the application of technology to education.

Why Is Educational Technology Important?

Technology has fundamentally transformed the way we live and work. From ATM machines to supermarket scanners, to the World Wide Web, technology has become a daily part of our personal lives. The same is true in the workplace. Technology has reshaped America’s offices, factories, retail establishments, and research institutions. Increasingly all workers are expected not only to have basic technology skills, but also to use technology in ways that will improve the “bottom line.”

Against this backdrop, parents, educators, business leaders, and policymakers, alike, are clamoring for schools to capitalize on the information revolution, and

embrace a high-tech vision for education. In poll after poll, 80-90% of parents say that technology is essential to prepare their children for the 21st century. Many educators believe it is the silver bullet of school reform. College and university faculty regard it as a requirement for postsecondary success. And corporate America considers it a mandatory part of preparation for the workplace.

Technology is also the topic *du jour* among lawmakers. Unlike other educational issues such as school choice or national standards, there is strong bipartisan support for technology. Recently, the President, Vice President, and a host of state governors from both political parties, endorsed technology as a necessary tool for education. At last year’s national education summit, governors and business leaders made improving educational technology one of the two main goals for school change.

Dollars have followed this high level leadership. Last year, alone, spending on educational technology exceeded \$5 billion; this year it is expected to rise another billion. Although the dividends that educators can expect from this investment are not yet clear from research, many people are unwilling to wait for the

definitive large-scale study before getting on board. According to a spokesperson at the Education Commission of States, “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.”

What Do Critics Say About Educational Technology?

As an educational issue, technology enjoys unparalleled broad-based support. Nevertheless, some leading educators are beginning to warn against the wholehearted push toward technology. Samuel Sava, executive director of the National Association of Elementary School Principals, recently expressed concern over the rush to buy hardware, “when we do not have enough evidence on how best to use computers to help youngsters achieve in reading, mathematics, and writing.” Others have raised questions about,

- lack of technology planning;
- lack of teacher training;
- the price of technology coupled with the limited data on benefits;
- cutbacks in other school programs while technology costs soar;
- technology vendors gaining too much influence over school curricula;

- students spending too much time cruising “blue” places on the Internet; and,
- inequitable access for disadvantaged groups.

Although few critics question the value of computers in society, most feel that we have yet to harness the educational potential of this high-powered tool.

What Does Research Say About Educational Technology?

Research in the field, generally, falls into two streams, one dealing with the availability and *use* of technology, and the other focusing on *effectiveness*. Both areas are treated here. In addition, a concluding section on policy implications is provided.

Use of Technology

Studies of technology use suggest that schools have made rapid progress in acquiring computer technology. Just five years ago, the average school had only one computer for every 20 students. Today, schools average one computer for every nine students – an improvement of over 50%. But the number of computers in schools tells only part of the story:

- 59% of the schools have outdated technology; over half of the computers in these schools lack the

capability to use the Internet and multimedia technology.

- Only 3% of the schools have effectively integrated technology in the classroom.
- Students in poor or high-minority schools have less access to technology than students in other schools.
- Most teachers have not had the education or training to use technology effectively. Only 15% have had at least 9 hours of technology training.
- Drill and practice software is a major application of computers today, and the dominant application at the elementary level. About 80% of all technology-related activities in elementary schools involve drill and practice.
- Computers play only a modest role in learning for the typical student. Usage ranges from 30 minutes per student per week at the elementary level, to one hour at high school.

Thus, while schools have greater access to technology than ever before, there are significant gaps. Many schools lag behind in computer presence and quality; there are problems of obsolescence and lack of teacher training; and in many

schools, technology remains a marginal addition, infrequently used and, when used, consigned to routine fact-oriented learning.

Effectiveness of Technology

Traditional Applications. A substantial number of studies have been conducted over the past several decades concerning the effectiveness of traditional technology applications such as CAI or drill and practice programs. Findings from more than a dozen meta-analytic evaluations involving 500+ separate studies, can be summarized as follows:

- Students receiving computer-based instruction tend to learn more and learn faster; their gains exceed those of comparison groups by an average of 30%.
- Students receiving computer-based instruction also enjoy their classes more and have more positive attitudes towards computers.
- Benefits of computer-based instruction are greatest for lower achieving students and those with special needs.

Researchers are quick to point out, however, that these positive findings pertain only to “properly implemented” technology

projects. Most projects, they say, under-utilize technology or use it in ways that circumvent specific guidelines – a problem that can undermine studies of effectiveness.

“Authentic” Applications. The research cited above was based largely on technology programs developed and implemented before 1990. Research on newer, more authentic applications of technology is less extensive, impeded, in part, by the lack of appropriate evaluation techniques to assess desired outcomes. Still, some promising results have been reported in the literature (e.g., by the federal Department of Education, Rand Corporation, and ETS). Key conclusions from the most rigorous of these studies are summarized below.

- Students exposed to technology-rich environments generally perform *as well as* matched control groups on traditional standardized tests.
- Students in technology-rich schools, however, *outperform* control group peers in other, less frequently assessed areas such as
 - communication and presentation skills;
 - complex, multistep problem-solving skills;
 - high-level reasoning skills;
 - social awareness;

- data interpretation skills;
- the ability to represent information dynamically;
- the ability to work independently as collaboratively;
- initiative-taking; and,
- the ability to synthesize different points of view and effectively state issues.

- Teacher use of authentic technology generally results in
 - more student-centered teaching;
 - less lecturing;
 - increased individual instruction;
 - more time spent coaching and advising students;
 - increased interest in teaching, and,
 - increased productivity.

Policy Implications

With or without “hard” evidence of effectiveness, expenditures on educational technology will likely quadruple in the next ten years. Both the enormous costs and enormous potential of this tool argue for careful research on how it can be used to improve results. Although some favorable findings have been reported, far more well-designed studies will be required to obtain definitive, widely replicable data. Until monies are available for such studies, there are

steps that policymakers can take to promote more effective technology use:

- incorporating technology into existing or emerging education initiatives;
- linking technology with state curriculum frameworks and standards;
- developing guidelines for conducting local staff development;
- helping schools develop pedagogical plans for technology use;
- providing incentives for the validation and dissemination of promising technology programs;
- providing regional/local technology training and technical assistance; and
- encouraging business involvement in planning/implementing educational technology.

Educational technology, if used well, can make an important contribution to education. Realizing that potential, however, comes at a cost. The **bottom line** is that more research is needed on ways that technology can improve outcomes and do so in a cost-beneficial way.

For More Information:

U.S. Department of Education
Office of Educational Technology
www.ed.gov/Technology/

The *Balanced View* welcomes your comments on this topic. References used are available upon request.