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ABSTRACT

Research reports and articles on the effectiveness of technology in the student learning environment reflect a variety of opinions and conclusions. Educators who are making decisions about the use of technology will want to examine research results with the following questions in mind: Do research results and expert opinions support the continued integration of technology into schools and classrooms? If so, what is known from research and best practices about how to integrate technology into classrooms to achieve improved student learning? and What professional development is needed for integration of technology? This policy brief examines information supporting the variety of views--both negative and positive--and attempts to interpret that information in a meaningful way. Six steps for designing quality professional development are recommended, and guidelines for technology implementation are highlighted. (AEF)

MID-CONTINENT REGIONAL EDUCATIONAL LABORATORY

Policy Brief

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by Carol Kimble, Ed.D.

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Research reports and articles on the effectiveness of technology in the student learning environment reflect a variety of opinions and conclusions. On one end of the continuum, supporters cite research studies showing the positive impact of technology on student learning. On the other end, critics present strong arguments that there is little, if any, evidence from research to support the claim that the use of technology in classrooms is worthy of the resources it requires. This policy brief examines information supporting a variety of views — both negative and positive — and attempts to interpret that information in a meaningful way.

Educators who are making decisions about the use of technology will want to examine research results with the following questions in mind:

1. Do research results and expert opinions support the continued integration of technology into schools and classrooms?
2. If so, what is known from research and best practices about how to integrate technology into classrooms to achieve improved student learning?
3. What professional development is needed for integration of technology?

Technology is here to stay

Most of the 88 million offspring of baby-boomer adults find using digital technologies (such as computers and video games) no more intimidating than using a VCR or a toaster. In his book, *Growing Up Digital* (1998), Don Tapscott called these children the "Net Generation." He suggested that these media-literate kids watch much less television than their parents did at the same age. Since TV is not interactive and does not allow viewers to have dialogue with one another, Tapscott wrote, the current generation finds it somewhat old-fashioned. Today's kids — two-thirds of whom use a personal computer either at home or at school — want to be active participants, not just viewers or listeners. Tapscott cited a 1997 survey by Teenage Research Unlimited in which more than 80 percent of teenagers polled said it is "in" to be online, a rating that puts being online on a par with dating and partying!

Technology is now used throughout the world for gathering information, keeping records, creating proposals, constructing knowledge, performing simulations to develop skills, distance learning, and global collaboration for lifelong learning and work. Its pervasive use across almost all aspects of modern life — including business, industry, communication and entertainment — warrants continued efforts on the part of educators to prepare students for participation in a technological world. Doing so effectively requires gathering information from research and best practices in technology and learning.

Research supporting technology's use

An examination of information from studies on the use of technology in classrooms yields three general observations. First, research studies and meta-analyses provide evidence of the positive impact of technology on student learning under specific conditions. Second, because research findings often reflect a narrow set of conditions, they require careful interpretation if used to support broad

decisions about technology integration. Third, research methods to determine technology's impact on student learning are changing, due to rapid changes in the technology itself and the way it is used.

A recent study by Harold Wenglinsky (1998) examined technology's impact on student learning in mathematics for fourth and eighth graders. Student performance was measured using the 1996 National Assessment of Education Progress. Wenglinsky concluded that technology does affect academic achievement and its impact depends on how the technology is used. The grade-appropriate use of computers was found to be more important in producing increased learning than the amount of time computers are used. According to the study, when computers are used to perform tasks applying higher order concepts and when teachers are proficient in directing students toward productive uses, computers are associated with significant learning gains.

The study also pointed to the need for high quality, intensive and continuing professional development focused on teaching models that integrate higher-order skills. Professional development, the author concluded, should focus on using computers for projects and problem solving that support the topics being introduced in the classroom.

Surveys and field research by Henry Jay Becker, a professor of education at the University of California, Irvine, showed increases in learning when students used the computer to enhance sophisticated writing and complex reasoning activities (Salpeter, 1998). These skills are difficult to measure and are only recently the focus of research. Becker concluded that educators should move away from teaching isolated technology skills and instead include more constructivist learning opportunities in order to take full advantage of the technology.

James Kulik and his colleagues from the University of Michigan completed numerous meta-analyses over the past 15 years to determine the effectiveness of computer-based instruction on student learning (RAND Critical Technologies Institute, 1995). Kulik's work showed that students usually learn more, and in less time, in classes with computer-based instruction. Students reported enjoying classes more when they received computer help and they learned as much or more from computer-based tutoring as from peer and cross-age tutoring.

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Larry Cuban, a professor at Stanford University, has studied the impact of computers in classrooms for the past 15 years (Salpeter, 1998). His work supports previous research conclusions that drill and tutorial software positively impact student learning. Cuban called for more research to support early conclusions that students using software for simulations and information processing require the presence of a teacher. He said educators first should determine the goals of the school or district, then decide how technology can help reach those goals. According to Cuban, it is also necessary to determine what has to change in the current instructional process and environment in order to integrate technology effectively.

A 10-year Apple Classrooms of Tomorrow (ACOT) research project found that when technology was integrated into good writing instruction, students were more engaged, writing more per minute and able to use more descriptive vocabulary than they could without technology (Salpeter, 1998). ACOT research documented that students and teachers using technology adopted a more collaborative learning environment. The ACOT project recommended that 30 percent of available technology resources be dedicated to providing ongoing staff development for teachers who are implementing its use.

Critics contribute valuable perspective

Those who are making decisions about the use of technology in the classroom should give thoughtful consideration to research reports that are critical of its use. The views of critics can provide a different perspective that will help balance decisions on technology implementation.

One such critic, Todd Oppenheimer, in an *Atlantic Monthly* article (1997), focused on the need for different instructional processes and better preparation of teachers. Although Oppenheimer voiced what seemed to be only critical statements, he referenced scenarios representing strong successes. In one example, students at the Thurgood Marshall High School in San Francisco were highly motivated and using computers to create models for real-world problem solving. They were successful because they were using appropriate processes implemented by one highly skilled teacher. Oppenheimer felt this instance did not reflect a typical level of teacher knowledge and, therefore, was not realistic. The example could, however, provide support for meaningful, ongoing professional development to ensure that high levels of teacher knowledge become the norm.

Diane Ravitch (1998) criticized how computers are acquired and deployed in schools, often through large purchases made possible by eliminating art and music programs. Ravitch charged that using computers to replace teachers is a practice which has not been shown to be effective or desirable. She called unfacilitated surfing of the Internet by students a waste of time which does not provide students the academic skills or knowledge needed to participate in the modern world. She contrasted the small amounts of technology funding allocated for appropriate professional development with large investments made for hardware and software.

Jane Healey voiced a number of concerns in her book, *Failure To Connect* (1998). She asked if unlimited access to computers in early primary years at the expense of more concrete learning experiences is helping or harming the development of children. Healey voiced concern about the lack of thoughtful technology implementation in all grades and suggested downplaying skill-and-drill math and phonics activities in favor of interactive problem solving and open-ended learning with supervised use of the Internet. She recommended beginning with hands-on and interpersonal activities and suggested practicing face-to-face interviewing skills prior to interviewing "experts" online. These and other guidelines from Healey align with what is known from research about effective technology integration and provide additional support for assuring quality professional development.

Interpreting research results

What can we conclude from a review of studies on the instructional value of technology? Some research studies show technology has a positive impact when drill and tutorial software is used. Others demonstrate an increase in student learning when computers are used for problem solving with a focus on authentic, real-world situations requiring local and global collaboration. Still other studies show technology can make a positive difference in the quality and quantity of writing through the use of improved processes and content. When technology is properly implemented in the classroom, according to research results, it can result in increased student self-confidence and eagerness to learn.

Those who are serious about improving student learning through the use of technology can learn much from critics about how to strengthen the process.

Most critics don't refute positive research results but instead criticize the way technology is used in classrooms, the technical expertise and preparedness of teachers, and the relative costs of acquiring technology. Those who are serious about improving student learning through the use of

technology can learn much from critics about how to strengthen the process. Critics and supporters of technology often share many beliefs. Both recognize the value of technology when the intended student learning is clear and focused on appropriate uses. Nearly everyone agrees on the need for ongoing professional development for new and experienced teachers to develop appropriate technology integration processes.

Both supporters and critics clearly identify a need for continued research on instructional models that use technology tools for information gathering, processing and knowledge construction.

Research studies have examined the impact of technology in relation to a variety of factors, including specific software, learning strategies, grouping, content area, age and grade level, literacy, multimedia features, use of laser discs, school-to-work skills, information accessing skills, and distance learning, to name just a few. As more teachers and students gain access to computers, the variety of uses will grow, making continued research critical. Care must be taken to focus future research on understanding how learning and instruction should change to best use technology, rather than on the technology itself. The ongoing effort to evaluate the impact of technology is complicated by rapid changes in technology, educational processes and — most important — in the perspective, skills, technological sophistication and interests of students themselves.

Preparing the three million teachers in classrooms today to use technology effectively is still not a funding or practice priority.

Guidelines for professional development

Both supporters and critics point out the need for effective professional development, including the development of new instructional skills. When teachers integrate technology in ways that remove them from their role as "the sage on the stage," they need effective skills and strategies to improve student learning in their new role as "the guide on the side."

Preparing the three million teachers in classrooms today to use technology effectively is still not a funding or practice priority. It should be the first priority. The CEO Forum's 1999 report recommended the following steps for designing quality professional development:

1. Set relevant, realistic goals through the creation of a plan that will enable teachers to use technology and the expansive resources it makes available to improve student performance and achievement.
2. Include all stakeholders and capitalize on all resources by involving teachers, parents, students, administrators and community leaders in all planning and implementation phases.
3. Link professional development to the core lessons the teacher is teaching and to the skills the student is working to acquire through relevant experiences using technology.
4. Model best practices in all professional development by using technology to teach about effective technology integration processes to meet predetermined objectives.
5. Empower teachers and students to learn by doing, through the use of technologies such as distance learning, online networking and Web- and computer-based classes to learn, communicate and exchange ideas locally and globally.
6. Provide resources, incentives and ongoing support to create professional development activities that do not jeopardize teacher time with students or rely primarily on teachers' personal time.

In addition to the professional development needs of current teachers, it is important to consider the preservice requirements of the nearly two million

new teachers who will enter the profession over the next decade. The CEO Forum called for a strong, ongoing commitment from schools of education to prepare new teachers to integrate technology effectively into schools' and districts' curricula. Such a commitment will require an increase in technology funding to schools of education to provide faculty with necessary tools and professional development. It will also require that accreditation standards, licensure and certification programs be revised to support technology integration requirements.

The CEO Forum report stated "professional development for teachers is an ongoing, long-term commitment that begins with the decision to pursue a career in education and continues, through a combination of formal and informal learning opportunities, for the duration of a career." This commitment to career-long professional growth includes ongoing exposure to technology far beyond the intermittent sessions on how to operate computer equipment and software which are now commonplace. Technology must become an integral part of learning environments and instructional practice, with the intent of providing real results for students.

Directions and guidelines for technology implementation

Technology is most effective when educators: (1) decide what is the best way to use it within a particular context and content, and (2) pursue teacher training specifically related to the intended use.

Barbara Means identified several features required for successful technology implementation (RAND Critical Technologies Institute, 1995). She based these criteria on information gathered from nine case studies of schools recognized by the U.S. Department of Education for their efforts to use technology effectively for student learning. In these schools, the teachers were involved in developing the learning goals and determining the part technology would play in meeting those goals. The teachers were able to select what technology to use and how to use it. Regular classes provided adequate technology access with nonjudgmental technical support readily available. Teachers had time to learn to use the technology and to design technology-supported learning activities. Opportunities were provided for teachers to work together when needed in designing learning environments.

Technology integration decisionmakers should consider the knowledge and needs of students, teaching methods, the interchangeable role of the teacher and the learner, learning styles, and professional development requirements, as well as hardware, software and networking needs. Thoughtful decisions require knowledge about the use of all technologies available to meet the changing needs of this generation of learners.

Resources on the Internet

The following Internet resources provide additional information about technology's impact on classroom learning:

Papers by Chris Dede on Educational Technology — "Six Challenges for Educational Technology"
http://www.virtual.gmu.edu/index1.htm

Technology and Learning Online — Research Forum
http://www.techlearning.com/intervie.shtml

Education Week Online — Special Report: Technology Counts '98
http://www.edweek.com/sreports/tc98/

Milken Exchange on Education Technology
http://www.milkenexchange.org/

eSchool News http://www.eschoolnews.com/

Software & Information Industry Association
http://www.siia.net/

International Society for Technology in Education — National Educational Technology Standards
http://www.iste.org/

The Thornburg Center
http://www.tcpd.org/

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