

**Effective Educational Technology Research - Context, Achievement and Trends**  
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**I. Context for Effective Educational Technology Use**

**Teacher Professional Development is absolutely necessary.** Placing technology in schools without attention to teacher professional development will almost certainly be a waste of money and a distraction to learning.

- The success or failure of technology is more dependent on human and contextual factors than on hardware or software.
- The extent to which teachers are given time and access to pertinent training to use computers to support learning plays a major role in determining whether technology has a positive impact on achievement. Students of teachers with more than 10 hours of training significantly outperformed students whose teachers had five or fewer hours of training.
- The success or failure of technology involves determining where it can have the highest payoff and then matching the design of the application with the intended purpose and learning goal.
- A significant portion of the technology budget should be allocated for professional development. School districts typically devote no more than 15 percent of their technology budget for teacher training, but a better amount would be 30 percent (Office of Technology Assessment, 1995).

**Effective Professional Development requires attention to multiple factors.**

- ***Connection to Student Learning.*** The ultimate goal of professional development is to improve student learning.
- ***Hands-On Technology Use.*** Recent research has shown the importance of current professional development emphasizing hands-on technology use.
- ***Variety of Learning Experiences.*** Research indicates that teachers learn and incorporate new information best when it is presented over a long time frame instead of a single session.
- ***Curriculum-Specific Applications.*** If technology is to be used to produce improvements in student achievement, teachers must see a direct link between the technology and the curriculum for which they are responsible.
- ***New Roles for Teachers.*** Technology encourages teachers to take on new and expanded roles, both inside and outside of the classroom.
- ***Collegial Learning.*** A professional development curriculum that helps teachers use technology for discovery learning, developing students' higher-order thinking

skills, and communicating ideas is new and demanding and thus cannot be implemented in isolation.

- **Ongoing Process.** A high-quality professional development program is conducted as an ongoing process, not a one-shot approach.

**Successful educational technology use requires knowledgeable administrators who understand and support its use.** Technology leadership is a combination of strategies and techniques that are general to all leadership, but require attention to some specifics of technology, especially those related to providing hardware access, updating rapidly changing technology, and recognizing that professional development and the use of technology are constantly evolving.

**Successful educational technology use requires having sufficient access to hardware and applications that are appropriate to the learning expectations, and recognizing that technology is not a one-time purchase.** The success of technology depends on having significant critical access to hardware and applications that are appropriate to the learning expectations of the activity.

**Successful educational technology use requires a high level of technical support.** Infrastructure repair or upgrades must be responsive and well timed. Frequent occurrences of a server being down, printers jammed, or insufficient computer memory will not only disrupt instructional and administrative activities, but also may undermine the entire technology program.

**Successful educational technology use requires ongoing evaluation.** Effective evaluations need to find emerging problems while they can be fixed.

## **II. Research Findings About the Effectiveness of Technology Use in K-12 Education**

**When important context considerations are in place, educational technology use has a positive effect size in the range of .35 to .45 or a small positive impact on normed tests.** A recent meta-analysis of quantitative research that considered only research studies with very strict methodologies requiring control groups found evidence that “teaching and learning with technology has a small, positive, significant ( $p < .05$ ) effect on student outcomes when compared to traditional instruction” (Waxman, Connell, & Gray, 2002, p. 2). Waxman et al. (2002) study reported a positive effect size of .43 for groups using technology. These findings closely parallel the conclusion of the National Science Foundation (NSF)-funded Kulik (2002) study that also considered only studies with clearly structured case studies. After examining 36 controlled studies, Kulik (2002) reported a positive effect size of .36 when all the studies were considered.

**When important context considerations are in place, laptops have similar academic gains, but research indicates that laptops have some additional benefits.**

- Laptop use improves students' school attendance and attitudes toward school (Stevenson, 1998; Rockman et al., 1998; Hounshell, Hill, & Swofford, 2002; Hill, 2003).
- Several studies reported that laptop projects encouraged and helped sustain inquiry-oriented, project-based, and long-term classroom activities.
- Laptop students rated their confidence in computer skills more highly than non-laptop students.
- Some studies, such as the Maine Learning Technology Initiative, showed slightly higher achievement in certain subjects when compared with control groups that had high use of technology subjects, but other laptop studies did not show similar gains for the same areas or grades.

**Technology, when used appropriately, produced positive changes in instructional practices.** Some studies have found that technology can change teachers' pedagogic practices from a teacher-centered or teacher-directed model to a more student-centered classroom where students work cooperatively, have opportunities to make choices, and play an active role in their learning.

**Technology is very important for special population students, especially for those in need of assistive technology.** Technology has proven to be an effective motivator for students with specific learning needs and in accommodating learning styles. Students working in collaborative team learning settings appear to function better when learning events are accompanied by technology use.

**Computers have a significant impact on learning and practicing 21st century skills such as finding information, organizing data, and analyzing and communicating solutions.** Technology integration means more than simply using the overhead to display information, a computer to input grades, or using the Internet to do research. It is about using technology as a tool to enhance teaching, learning, and multisensory experiences, providing "a range of pathways for students at varying levels" (Ficklen & Muscara, 2001, p. 26).

**Students who use computers in schools are better prepared to use the Internet more effectively.** The Internet is becoming an increasingly vital tool in our information society. More Americans are going online to conduct such day-to-day activities as education, business transactions, personal correspondence, research and information-gathering, and job searches. Each year, being digitally connected becomes ever more critical to economic and educational advancement and community participation. Now that a large number of Americans regularly use the Internet to conduct daily activities, people who

lack access to these tools are at a growing disadvantage. Therefore, raising the level of *digital inclusion* by increasing the number of Americans using the technology tools of the digital age is a vitally important national goal (Glenn Commission Report, 2000).

### **III. Technology Use Trends**

**Online learning is increasingly becoming a more important instructional delivery option for providing learning opportunities for both teachers and students, especially in rural schools.** Last year, West Virginia enrolled 1,200 students in 115 different online courses supplied by five content providers: Apex Learning, Florida Virtual School, Intelligent Education Inc., Stanford University, and Virtual Green Bush. In almost all cases, tuition for these courses is paid for by a grant from the state legislature. This was seen as a means to create equitable opportunities for students, provide access to high-quality certified teachers as required by NCLB, and give more options to learners.

**Many of the most powerful uses of technology are Internet dependent because increasingly the most recent and powerful applications and content are only available on the Internet.**

- Accessing information, especially from the Internet, and using that information to communicate findings to others by using graphs, illustrations, and animations.
- Reading and language arts, for phonological awareness, vocabulary, reading comprehension, writing, and spelling.
- Writing in content areas where an increasing trend is sharing of student products with other schools and professional authors to obtain real audience-quality evaluations of both the writing and the treatment of the content.
- Mathematics, to support mathematics curricula that focus on diagnosing and remediating, providing support for fundamental knowledge deficiencies, and for simulating and solving real problems with tools that are similar to tools that mathematicians use.
- Science, to simulate and solve real problems, especially when scientific probes and other technology tools are used to assist with laboratory experiments.
- Social studies, to simulate events and when students are allowed to use the multimedia power to demonstrate student work.
- Health, for research and for personal, family, and community health self-assessments.
- Music, to teach musical theory and composition.

- Art, to view virtually the greatest artworks and to learn art composition and design.
- Foreign languages, to communicate with native speakers about cultural implications and language nuances.
- Individual Technology, to show complex mechanical interactions.

**Computer animation is growing in importance as its success becomes more known.**

Computer animation software is helpful because it provides visual and “representation” support to concepts that are often very abstract when limited to print and auditory delivery. Animation is especially helpful when dealing with concepts that:

1. Take place over a long period of time, such as continental drifts;
2. Take place too quickly to be grasped in real time, such as engine cycle;
3. Are microscopic, such as viral infection;
4. Are macroscopic, such as astronomical motion;
5. Have many complex sub-processes, such as photosynthesis;
6. Require concrete visual representations or qualities, such as speed, density, or temperature (Garcia, 1999).

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