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## Technology and Student Achievement

**Indicators show that technology has the potential to transform education when integrated with emerging models of teaching and learning.**

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by Nancy Protheroe

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For the past 25 years, as schools continue to invest in constantly changing technology, one question remains unanswered: "Is there evidence that using technology leads to higher levels of student learning?" The need for an answer has become more urgent in recent years due to two key factors—an emphasis on standards-based accountability and the substantial financial, instructional, and organizational costs—involved in purchasing and implementing technology.

### Looking at the Research

Research does not allow us to unequivocally state that technology presents a cost-effective way to improve student achievement. The relationship between the two is complex, and problems with research methodology make it difficult to show more than a correlative relationship. It is also next to impossible to control all the variables in the imperfect research environment of schools (Herman 1994). To compound the issue:

- Schools have often been uncertain about the outcomes they want to achieve with technology. Is the goal to increase test scores, prepare students for jobs, increase student access to information, or prepare critical thinkers? (Heinecke et al. 1999).
- Assessments of the impact of technology are really assessments of instruction supported by technology. The effectiveness of the technology is directly tied to the effectiveness of the instructional design, content, and teaching strategies employed by the teacher (Glennan and Melmed 1996).
- Most achievement tests do not reliably measure the wide range of outcomes sought. New measures need to be used that can assess outcomes such as improved problem-solving skills, deeper understanding, and higher motivation, all of which may be affected by the technology (Glennan and Melmed 1996).
- The dynamic nature of technology makes meaningful evaluation difficult. By the time long-term studies are completed, the technology being evaluated is often outdated.

Because the technology available to schools, as well as how it is used, has changed

dramatically in a brief period of time, an “old” research base cannot provide the answers needed to today’s questions. However, a review of what we have learned can be helpful in informing current practice and future directions.

Schacter and Fagnano (1999) presented findings from several meta-analyses indicating that computer- based instruction moderately improved student learning.

Kulik (cited in Kosakowski 1998) presented evidence that using educational technology for drill and practice of basic skills could be highly effective, and Becker (cited in Mergendoller 2000) concluded that students using computer-based integrated learning systems generally did somewhat better than expected.

Stratham and Torell (1996) reviewed 10 meta-analyses on the effectiveness of technology. Their findings indicated that:

- When properly implemented, computer technology had a significant effect on student achievement, as measured by test scores across subject areas and with students at all levels.
- When used appropriately, computer technology stimulated increased teacher-student interaction and encouraged cooperative learning, collaboration, problem-solving, and student inquiry skills.
- Students from computer-rich classrooms demonstrated better behavior and had lower absentee and drop-out rates than students from class- rooms lacking computers.
- Computer-based teaching was especially effective among populations of at-risk students.

Sivin-Kachala *et al.* (2000) analyzed 219 recent research studies to assess the effect of computer technology on learning and achievement across all learning domains and all ages. In addition to positive effects on achievement in major subject areas, they found effective use of technology fostered the development of more positive student attitudes toward themselves and toward learning.

Studies on particular types of technology use are still being conducted. For example, a recent study of the impact of electronic field trips, provided for seventh and eighth graders by Maryland Public Television and the Johns Hopkins University Center for Technology in Education, found participating students exhibited significantly higher levels of knowledge on three social studies units than students who had not participated. Participating students also demonstrated greater improvement on reading comprehension skills (ORC Macro 2005).

### **What Other Questions Should We Ask?**

Researchers have also attempted to identify factors that could increase the possibility that technology use will have a positive impact on achievement. For example, Waddoups (2004) analyzed 34 research studies designed to identify the impact of technology integration in teaching and learning on student outcomes. He synthesized several themes in the research into four principles:

- Teachers, not technology, are the key to unlocking student potential. A teacher’s training in, knowledge of, and attitude toward technology and related skills are central to effective technology integration.

- Curriculum design is critical for successful integration. Teachers must reconsider their methods and curricula in order to effectively integrate technology. They must factor in the needs and situations of learners and their ability to make use of technology.
- Technology design largely determines the impact of integration efforts on student achievement. It must be flexible enough to be applied to many settings, deliver rich and timely feedback, and provide students multiple opportunities to engage with the content.
- Ongoing formative evaluations are necessary for continued improvements in technology integration.

### **Linking Technology with New Teaching Models**

Johnston and Cooley (2001) urge educators to look at emerging models of teaching and learning and ask how technology might support them:

*“Integrating technology into the curriculum in today’s schools should not mean finding ways that computers can help us teach the same old things in the same old ways. Instead, school leaders have the opportunity to combine technology with emerging models of teaching and learning to transform education.”*

They address two key elements of new models of teaching and learning that can be supported by use of technology:

***Opportunities for Collaboration.*** The collaborative approach to learning engages students in the learning process and teaches them a lifelong skill.

***Opportunities to Construct Knowledge.*** Constructivism—giving students opportunities to construct their own knowledge—provides students with learning experiences that help them build on their prior knowledge.

Shank (2000) points out that computers, Web-based technologies, and multimedia presentations are already reshaping the American education system. Examples include online courses, increased use of “learning by doing” experiences for students, and collaborations at-a-distance between students and experts. Research has found that effective integration of technology may actually encourage teachers to move away from reliance on traditional models of instruction. In Byrom’s words, “over time, technology use changes the way teachers teach” (undated).

### **Planning for Effective Use of Technology**

Developing successful lessons that incorporate the use of technology requires thoughtful planning and attention both to the purpose of the instructional activity and to the needs of the students. Traditional questions of instructional planning still apply:

- How does the lesson fit into the curriculum?
- What are the lesson’s specific educational goals?
- What will the students learn as a result of this activity?
- What materials and activities will be needed for the lesson?
- What experiences do the students have with data analysis and thoughtful discussion?
- How will students know what is expected of them?
- How will students demonstrate what they have learned as the result of this activity?

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