This Spotlight presents the findings of a survey of over 200 landmark research studies of the effects of computer technology on student learning conducted by the U.S. Army Research Institute for Behavioral and Social Sciences, the Consortium Research Fellows Program, and the Boise State University College of Education. Findings from the survey indicate that the appropriate use of technology contributes to student learning. With proper implementation, computer technology can transform the classroom and create a superior learning environment.

In his executive summary of the present report, Robert D. Barr, Dean of the College of Education at Boise State University, notes that, "During recent years, public education throughout the United States has been transformed through technology. And while developments in education lag far behind business, industry, and higher education, the technological revolution is finally touching the lives of school children and youth...State legislators are investing heavily in technology; the federal government is focusing support on infrastructure and curriculum development; and many school districts across the country have passed local technology bond issues specifically designed to move computers into school classrooms. Business and industry have also assisted school districts, and more and more communities are collecting donated computers and recycling them into schools...School districts are struggling to deal with all of these activities. They are developing strategic plans, installing infrastructure, purchasing computers and software, integrating technology into the curriculum...and they are retraining teachers."

Dr. Barr goes on to note that, throughout this revolution in technology, the question of whether computers in the classroom impact on student learning has been voiced in state legislatures, school board meetings, the superintendent’s office, parent organizations, and throughout Washington, DC. Until recently, however, the answer to the question has been: "We do not know."

CONCLUSION 1

When properly implemented, the use of computer technology in education has a significant positive effect on student achievement as measured by test scores across subject areas and with all levels of students.

The most comprehensive study on the effectiveness of using computers to enhance learning was published by Kulik and Kulik (1991). Their report included data on more than 240 studies of elementary, secondary, college, and adult students, the majority of which were focused on K-12 students.
In 81% of the studies reported by Kulik and Kulik, students in the computer-based instruction (CBI) classes had higher exam scores than did students who were taught by conventional methods without computer technology. The typical student in an average CBI class performed at the 62nd percentile on achievement exams; the average student in a conventionally taught class performed at the 50th percentile on the same exam. The average student from the CBI class outperformed 62% of the students from the conventional classes.

Similar conclusions about the relationship between student achievement and computer use are reported in the other meta-analyses as well as in individual research studies.

CONCLUSION 2

When used appropriately, computer technology in classrooms stimulates increased teacher/student interaction, and encourages cooperative learning, collaboration, problem-solving, and student inquiries.

In computer-rich classrooms, teachers interact differently with students, functioning more as guides or mentors and less as lecturers; team with other teachers; and work across disciplines.

With computers, students cooperate and collaborate more with their peers. Particularly in elementary and middle grade settings, recitation and seatwork are balanced with interdisciplinary, project-based instruction. Use of computers appears to have a democratizing effect on classrooms.

Empowered by technology, teachers and students are free to explore problem solving, creative thinking, and expressive writing and speaking. Effective use of technology can improve teacher collaboration; increase interdisciplinary instruction and cooperative learning; and help teachers be available to students and parents.

CONCLUSION 3

Students from computer-rich classrooms show better behavior, lower school absentee rates, lower drop-out rates, earn more college scholarships, and attend college in greater numbers than do students from non-computer classrooms.

By giving students the opportunity to use computers effectively, the focus is placed on empowering students to take an active, participatory role in learning. As a result, self esteem is enhanced, and attitudes toward school improve. Increased student motivation and decreased discipline problems are common in technology-rich classrooms. Student absenteeism in a computer-rich secondary school program was cut almost in half. Ninety percent of the graduates went on to college, even though at the 8th grade half of them had not elected any college preparatory classes. Those students received a variety of recognitions for outstanding accomplishments, and 78% of the graduates earned academic awards.

The strength of technology is that it provides an excellent platform where students can collect information in multiple formats and then organize, link, and discover relationships among facts and events. An array of tools for acquiring information and for thinking and expression allows more students more ways to enter the learning enterprise successfully and to live productive lives in the global, digital, information-based future they all face.

CONCLUSION 4

Computer-based teaching is especially effective among populations of at-risk students.

Many students who are at high risk for school failure have the potential to learn; but their academic achievement in the core areas of reading, mathematics and writing falls far short of their potential. There is growing evidence that the
academic difficulties experienced by these students is cumulative in nature, and the gap between achievement and potential grows from childhood into adolescence. These young adults tend to drop out of school more frequently than do students without these difficulties, and they experience higher levels of unemployment and underemployment. As a group, they face a significant risk for lifelong problems.

The benefits of computer technology are especially notable with high risk students. The use of technology can be less threatening to a student who has already experienced many failures in traditional classrooms situations. Standardized testing has revealed that positive gains can be made in both reading and math, with students in the experimental computer-rich programs raising their scores from below average to average. Some of the highest gains in achievement consistently come when at-risk students are afforded the opportunity to access computer technology.

ESSENTIAL CONDITIONS

Although there is growing agreement surrounding the positive benefits resulting from the use of computer technology in education, the actual effective implementation is far more demanding than ever expected. Computers have not yet become the major medium for instruction, and computers in most subject-matter classes still serve primarily for enrichment activities or for remediation. It is not sufficient to simply provide finances to purchase computer hardware and software. We must learn how to maximize the effects of computer technology on student learning, how to organize classrooms, how to train teachers, and how to integrate computer technology in the curriculum.

In the course of this research, a number of issues surrounding the application of computer technology in the classroom were identified. The factors discussed below are essential conditions or prerequisites which must be addressed in order for computers to have a significant impact on classroom education.

Essential Condition 1: Access

- One computer is needed for every two to five students.
- Students must have a minimum of one hour per day at the computer.

Essential Condition 2: Integration

- Teachers need to integrate computers and curriculum into the teaching/learning process, shifting the instructional environment to one emphasizing the location of relevant information and the learning of problem-solving skills.
- Teachers must be trained to use computers effectively. The training should be sequenced in short, incremental lessons interspersed with actual classroom implementation and access to consultation, advice, and problem solving.

1Research conducted under the direction of Dr. Ruth Phelps, U.S. Army Research Institute, and Dr. Carolyn Thorsen, Boise State University.

For a copy of the complete research report, "Computers in the Classroom: The Impact of Technology on Student Learning," please write to the Army Research Institute, 1910 University Boulevard, Boise, ID, 83725; or call 208-334-9390.

Spotlight on Student Success is an occasional series of articles highlighting findings from the Laboratory for Student Success (LSS) that have significant implications for improving the academic success of students in the mid-Atlantic region. For more information on LSS and other LSS publications, contact the Laboratory for Student Success, 9th Floor, Ritter Annex, 13th Street and Cecil B. Moore Avenue, Philadelphia, PA, 19122; telephone: (215) 204-3000; E-mail: <LSS@vm.temple.edu>.