Benefits of Technology Integration in Education

Abstract

With a great deal of investment being put into outfitting schools with technology, the question of whether or not it is worth the investment is a valid one. This essay describes the benefits of utilizing technology in education by examining research from around the world which demonstrates that there is ample evidence for supporting the usage of technology in educational environments. Recommendations for further research are made at the conclusion.

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Benefits to the Integration Technology in K-12 Education

The benefits of technology in education have been lauded for many years, from Thomas Edison's 1910 proclamation that film would transform education, making books obsolete (Israel, 1998, p. 442) to the most recent phenomenon of using the Internet for instructional purposes. Large sums of money have been spent over the years on the researching and investment of new technologies for education, such as the 170 million dollars spent in the 1950's on testing the use of television for educational purposes by the Ford Foundation, to the more recent investments in computer and networking infrastructure in schools which saw forty billion dollars spent in the decade leading up to 2003 alone. With so much promised and invested, the question begs as to what the benefits of using technology in education are, if indeed, they exist at all. This paper addresses that question by describing several of the benefits that technology brings to education including improvement in student achievement on tests, the benefits for students who have special needs and who are at-risk, improved attitudes towards learning, individualized learning, and the role of technology in acting as a catalyst for change in school pedagogy.

Technology Improves Student Achievement on Tests

There is mounting evidence that technology improves student achievement on tests in both core subject areas as well as overall GPA. One of the major areas in which greater achievement has been seen is in math. The Moore Independent School District in Oklahoma used a Cognitive Tutor computer based curriculum in 5 junior high schools and found that students who learned using the cognitive tutor curriculum outscored students who were enrolled in a traditional Algebra curriculum on the ETS Algebra I End-of-Course test (Morgan, 2002). They also found that the results held for students of both sexes and all ethnicities represented in the data (Morgan, 2002). Similar results were found at the high

school level in Pittsburgh, Iowa where the Pittsburgh Urban Mathematics Project (PUMP), an algebra curriculum that combines a constructivist approach in studying real world situations and the use of computer tools, was implemented. They found that there was a 15% improvement on the Iowa Algebra Aptitude Test, which was significantly higher than the comparison group (Koedinger, 1997). They further concluded that students who were in the PUMP program did so "at no expense to basic skills objectives of standardized tests" (Koedinger, 1997). Better achievement on standardized tests were also found in another study done at a large high school in the western United States which found that students who learned geometry using computers utilizing a constructivist approach had made stronger gains in knowledge of geometry concepts than students in a control group using traditional methods (Funkhouser, Winter 2002/2003).

Evidence that computers in education lead to improved achievement is not only found in the subject of mathematics. The Harvest Park Middle School, located in the Pleasanton Unified School District in Pleasanton, California, which established a one-to-one laptop program in 2001, found that students who participated in the program tended to get "significantly higher test scores and grades for writing, English-language arts, mathematics, and overall Grade Point Averages (GPAs)" (Gulek, 2005). In fact, students scored at proficient or advanced levels, on average, 17% more than students who did not participate in the program (Gulek, 2005, pg. 17). They also found that a "substantially higher percentage of laptop students met or exceeded grade level expectations in writing" (Gulek, 2005, pg. 15).

More recently, a similar program to the laptop initiative in Harvest Park was implemented in Michigan through the Freedom to Learn Program in 196 schools including over 5,000 students. Research analysis of the program concluded that students which participated in the program had mean scores that were higher or equal to those in the control group (Lowther, 2007). Further, students outperformed control groups in math, writing and

English in the majority of schools that were considered to be implementing the program effectively (Lowther, 2007, pg. 13).

Gains in test achievement are not only seen as a result of using technology to study, but also in the use of technology for assessment, particularly for students with special needs. Students that have physical and learning disabilities may underperform on tests not because they have not mastered the content, but possibly because of the format through which the test is administered (Dolan, 2005). A study done with children with dyslexia found that providing computer-based read-aloud support to students improved their performance on a multiple-choice United States history and civics tests (Dolan, 2005). The read aloud support offered them alternatives to "reading" texts and responding to comprehension questions. In particular, when questions had more than 100 words, a significant increase in scores[1], was found (Dolan, 2005, pg. 21). This is attributed to the possibility that such students, who normally had been intimidated by longer passages on pencil and paper exams (and would therefore skip reading them), instead used the read-aloud support to listen to and consequently answer the previously skipped sections (Dolan, 2005).

Technology Improves the Quality of Student Work

Research supports that technology has the potential to improve quantitative assessment performance in core subjects, as well as overall GPA. However, there is also mounting evidence that technology not only has a quantitative advantage over traditional methods, but also leads to qualitative improvements; resulting in higher-quality student work. The Harvest Park Middle school found that "students who use computers when learning to write are not only more engaged and motivated in their writing, but also produce work that is of greater length and higher quality, especially at the secondary level" (Gulek, 2005, pg. 29). Improvement in writing when utilizing technology is especially evident in regard to students

[1] Approximately 22

with special needs and low-achievers. Such students appear to improve even more than both average students and high-achievers when doing so via word processor rather than with conventional Instructional methods (Hannafin, 1987).

Technology Benefits Students with Special Needs

Improved writing is not the only area in which students with special needs benefit from technology. One study found that students with Dyslexia improved significantly in reading ability when a computer remediation program, Fast ForWord Language, was used and that in some cases dyslexic student scores were raised into the normal range (Temple, 2003). It was found that such remediation led to "improved language, reading performance and increased activation in multiple brain regions during phonological processing"(Temple, 2003, pg.4).

Technology Benefits At-Risk Students

Another group that benefits greatly from learning with technology is at-risk students. The Pittsburgh (PUMP) study found that students that may normally be disruptive in the classroom are more engaged and cooperative when using technology to learn (Koedinger, 1997). It concluded that technology makes them more engaged and leads to better learning and better attitudes towards learning.

Technology Improves Attitudes Towards Learning

At risk students are not the only ones that respond positively to the use of technology in learning. Many research studies have found that most students prefer learning with technology, which in turn leads to a better attitude towards learning as well as giving them more confidence. In the Cognitive Tutor study, students were found to be more likely to say that mathematics is useful outside the academic context and to feel more confident in mathematics than students in traditional classes (Morgan, 2002). Students in the Freedom to

Learn study were found to believe that education "made it easier to do school work, made them more interested in learning, and would help them get better jobs in the future" (Lowther, 2007). The students with special needs in the Fast ForWard study, similarly, felt that they did better on computer based tests and nearly all recommended the program for other students (Dolan, 2005).

Although many studies find that student attitude towards learning improves using technology, some studies have not found significant difference in student attitude or motivation (Funkhouser, Winter 2002/2003). However, most research tends to support the correlation of improved attitude with technology use.

Technology Provides Individualized Learning

One aspect which may contribute to improved attitude towards learning is that many uses of technology in learning allow for individualized learning. Computer aided instruction, especially when used for drill and practice as a tool for teaching in a traditional sense, allows students to take control of the rate of learning and helps them to avoid embarrassment by allowing them to learn and make mistakes in a non-public manner. Koedinger states:

> Students know right away that they are making progress and having success at a challenging task. Further, because the system does not make a big deal out of errors, students do not feel the social stigma associated with making an error in class or on homework. Errors are a private event that are usually quickly resolved and the student is then back to making progress. (Koedinger, 1997)

Moreover, such computer assisted instruction provides feedback immediately which leads to reductions in learning time (Koedinger, 1997). This is very likely to be a key element in making students feel more confident as well as leading to better attitudes towards learning. Such feedback reduces student frustration and provides a sense of accomplishment (Koedinger, 1997).

The feedback and self-pacing aspect of computer assisted instruction is not only beneficial to students. Teachers also benefit from the way the tutor programs accommodate

a large number of questions students have. This frees them up "to give more individualized help to students with particular needs" (Koedinger, 1997) – which in turn benefits students with special needs and who are at risk.

Technology Acts as a Catalyst for Change

One of the greatest areas in which technology has the potential to benefit education is its role in being a catalyst for change in educational pedagogy. Research shows that student centered constructivist approaches to education lead to better achievement in testing as well as preparing students with the skills necessary in the modern workplace. One study done in Turkey found that students who learned in a classroom with a constructivist approach to learning showed greater cooperation and collaboration, higher levels of learning, more confidence, and more willingness to participate in learning activities (Erdamar, 2008). Other studies have found that student centered learning leads to better performance on tests and greater retention of knowledge immediately after learning as well as 30 days after learning (Karaduman, 2002).

One of the most researched projects which utilized technology with a constructivist approach were several LOGO computer programming projects in the 1980's. The program was developed by Seymour Papert, who postulated his own version of constructivist theory, the constructionist approach. He postulated that the biggest benefits to students constructing their own knowledge through computer programming would "be in the cognitive domain: problem solving, higher order thinking skills, and mathematics related subjects (Robinson, 1988). His program led to students performing better on achievement tests in mathematics (Robinson, 1988).

More recent studies, are finding that technology in the classroom can, in and of itself, lead to more student-centered practices being used by teachers (Lowther, 2007). Studies such as the Freedom to Learn project, in which there was a one-to-one laptop-to-student ratio,

found an increase “in teacher use of independent inquiry, project-based learning, meaningful laptop lessons, and higher quality hands-on activities”(Lowther, 2007).

Although technology may be a catalyst to change, several barriers to its integration-insufficient resources, lack of institutional and administrative support, lack or absence of training and experience, and attitudinal or personality factors (Brinkerhoff, 2006) - are more likely to determine whether computers in classrooms are used as traditional tools for learning or as a constructivist mode of learning. Said in another way, technology on its own will probably not be the determining factor in bringing about such change. As one study concluded, simply having computers in the room is not necessarily going to lead to student centered learning, indeed teachers may not even use the computer (Norton, 2000).

Technology Prepares Students for the Future

The future workplace will require students to have skills related to technology including the technical ability to use spreadsheets, word processors, databases and such. By having and working with technology in schools, students gain the skills that they will need to be marketable in the future workplace and to operate in a high-tech world. However, these technical skills are not enough. The modern workplace requires that one have less tangible skills including the ability to collaborate with others, interpersonal skills, creativity, and problem solving skills, to name a few. Technology, combined with a student centered constructivist mode of learning, has the potential to provide students with these higher-level cognitive and interpersonal skills.

The advantages of such a combination have been well documented in The Freedom to Learn study. By having a 1:1 ratio of students to computers and using a student centered learning approach, along with professional development of teachers and administrators, most of the barriers to full integration were overcome. As a result, students in the program used software more often than that of the national norm, engaged in meaningful computer

activities, did independent research and engaged in project based learning (Lowther, 2007). They also “exhibited a significantly higher ability in demonstrating understanding of the problem and in identifying what needs to be known to solve the problem” (Lowther, 2007, pg. 5). According to the report, they also have a significant advantage when it comes to doing presentations and using the Internet over students who were not in the program (Lowther, 2007).

Conclusion

Technology in education is neither a novelty nor is it a fad. It is a part of the modern world, and is becoming more and more ubiquitous in our lives every year. It is also a proven method for improving learning. There is strong evidence pointing towards technology leading to better results on standardized tests; however the real emphasis should not be on how it improves test scores, but on how it benefits student learning; how it enables those who are not able to perform at their peak in traditional classrooms to do better; how it motivates students to learn and gives them a more positive attitude towards education; how it can individualize learning by giving feedback; how it can act as a catalyst for change towards more student centered learning; and how it better prepares the youth of today with technical, communicative, interpersonal and creative skills. The question we should be asking is not whether or not technology should be in education, but what can we do to remove barriers so as to further the integration of technology into our schools. Hence, one area in which more research must be done is on how to best move towards more student centered learning with technology and how to best overcome barriers to doing so. Another suggested area for research is on how to provide students with special needs and students who are at-risk with more access to technology since they in particular benefit from using technology.

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