TECHNOLOGY IN THE CLASSROOM:
STRATEGIES, POTENTIAL BENEFITS, & CHALLENGES

Introduction

Technology is an integral facet of work and life in the 21st Century. Education is not immune from this reality, and practitioners and policy-makers see an increasingly technology-based global economy, more affordable technology for use in schools, and the potential to engage students with technology.

The increasing demand for the presence of technology has led to numerous policy options. Nationally and in Utah, there has been a surge of interest in one-to-one device adoption programs, where each student is provided a device and potentially software as well.

In a recent report, the Organization for Economic Co-operation Development (OECD), found "no appreciable improvements" in academic achievement in 31 countries that invested in technology in classrooms.[i] The report suggested that educational equity needs to be addressed initially in order to see a benefit from technology in the classroom. Without first addressing equity in the classroom, technology can amplify disadvantage.

We know that poorly implemented technology programs do not adequately address the intricacies of teaching and learning. Specifically, few technology programs address the most critical concern: how devices and software can be used to contribute to teaching and learning.

This brief discusses technology programs in schools, such as one-to-one device programs, mobile computer labs, or educational software, but refers to these programs generally as technology programs. The brief explores general strategies for effective implementation, potential benefits of technology adoption, and challenges for evaluating technology programs in their ability to increase learning outcomes.

Summary of Results

- ○ Device adoption programs, such as one-to-one programs or school technology programs that provide laptops/tablets to all students, are becoming increasingly popular nationwide.
- ○ Prior to implementation, school computer/technology programs should have clearly defined goals and plan for the following: effective communication strategies, professional development for teachers, adequate curriculum integration, technical support, program evaluation, and cost.
- ○ There are clear benefits from technology-enhanced teaching and learning, particularly in terms of experience with technology and the ability to gain technological proficiency, but gains in 21st Century Skills and academic achievement are less clear as a result of adopting technology in the classroom.
- ○ There are numerous challenges to evaluating the educational and social benefits of computer/technology programs.

Using evidence from research and evaluation on technology-enhanced education interventions, this brief discusses:
- · *Strategies to implement effective technology programs*
- · *Evidence of the potential benefits of technology in the classroom*
- · *Challenges of evaluating technology programs*

Strategies for Effective Implementation

Effective education reform policies and programs should incorporate lessons learned and strategies from prior implementations. School-based technology initiatives face numerous challenges that can hinder implementation, including misunderstandings of the intent and goals of the program. Evidence suggests that program goals and scope should be very clear for administrators, teachers, students, parents, and the public.[ii] Technology programs require an initial and ongoing investment of financial resources, personnel, technical support, training, time, software, infrastructure, and assessment/evaluation. While cost is often cited as a challenge to implementation, poor planning and a lack of goals are more frequently the factors that hinder an effective implementation of technology in schools and the classroom.[i,iii]

Clearly Defined Program Goals

The majority of reports on the implementation of technology programs cite the importance of clearly defined program goals by leadership at the state, district, and/or school level. Program goals should articulate how technology should be used in classroom[iii,iv], define educational outcomes[v,vi], and link the technology to educational outcomes.[v,vi] Leaders who outline clear goals and purposes for technology programs positively influence the teacher beliefs about the use of technology in the classroom.[vii]

Effective Communication Strategy

Clear communication about program goals and purposes of technology can support the successful implementation of technology in schools. Teachers have reported concerns about how technology integration impacts instructional time, instructional practices, educational outcomes, and classroom planning. They have sought specific guidance on how to integrate devices in the classroom, particularly instruction, in a meaningful way.[viii] Effective, timely and targeted responses by school leadership to such concerns can impact teacher beliefs and support of technology programs. This is also crucial to addressing parent and student concerns generally about technology programs, devices, software,

Considerations Prior to Implementation

o   Clearly defined program goals

o   An effective communication strategy

o   Adequate teacher training and professional development

o   Support of curriculum integration

o   Technical infrastructure and support for software and hardware

o   Assessments and evaluations of the device adoption program, including software and hardware

o   Program costs, including training, hardware, & software, both short- and long-term

expectations, and effectiveness. Another effective communication strategy is to employ technology coordinators. A technology coordinator can be available in schools and immediately address questions that, if gone unanswered, could lead to barriers to implementation.[viii]

Adequate Teacher Training and On-going Professional Development

Effective technology plans should include two facets of training: initial teacher training before program implementation and on-going professional development to enhance use. Initial training should address how to use devices, related software, and the integration of the technology with curriculum and pedagogy. Training should include paid time for teachers to acquire skills necessary to infuse technology into their pedagogy and opportunities to engage in training outside the regular school day[viii], as well as be tailored to the needs of individual teachers and teaching styles.[viii] Initial teacher training and on-going professional development require an investment of time and money from schools, districts, and/or states.[ix]

Curriculum Integration

Curriculum integration occurs when technology is infused into curriculum and throughout instruction.

Curriculum integration is one of the most difficult and widely cited implementation challenges of technology initiatives. Types of curriculum integration can vary, but may include using educational software for specific subjects or lessons, creating audio/visual presentations, or using the internet for research.[x] Often teachers will utilize resources on the internet to enhance the traditional curriculum or even place the whole curriculum online and solely rely on technology to deliver the curriculum.[x] Leaders can utilize frameworks that outline how to integrate technology in the classroom to help teachers better incorporate technology in the classroom.[xi] Research has demonstrated that this type of integration can lead to different academic outcomes, albeit with small effects.[xii,xiii] Curriculum integration with technology is a growing field in which software is key. It is often the case that the device is just a delivery tool via the software for the curriculum (See www.cate.utah.edu).[xiv]

Technical Infrastructure and Support

Technical infrastructure and support is an essential component of effective technology programs. Hardware can be fairly easy to distribute and set up in schools once purchased, but the ability to use the hardware to its specifications or capabilities and run software requires a distribution and oversight plan to ensure software is operable and current.[xv] Technology programs also need to include quality broadband internet that allows for multiple users to simultaneously access the network. Fast broadband access is often an issue in rural areas.[xvi] Fast computers and tablets are often not as useful without quality broadband internet.[xv] Some forms of technology like Chromebooks and tablets can simplify integration because they are simpler and quicker to deploy and are less susceptible to viruses. Technical support needs to be timely, thorough, minimally disruptive, and regularly scheduled to ensure that instruction time is not disrupted.[xvii] Technical support staff should be available in and to every school to ensure timely responses. Careful consideration of technical support prior to implementation is essential because regular support can be costly and a barrier to implementation.

Evaluation

The evaluation of technology programs is important to their initial and ongoing success because schools, districts, and states can implement program improvements or evaluate the extent to which the program met program goals. An evaluation should address four aspects of a technology program, including impact, effectiveness, appropriateness, and satisfaction.[xviii] First, an evaluation needs to evaluate how a technology program impacts student outcomes as defined by the district or state. Second, evaluations should investigate the effectiveness of the teacher training and technical support. Third, evaluations should continually evaluate the appropriateness of hardware and software selected for schools, including the degree to which the technology meets intended outcomes. Finally, it is important to assess student and teacher satisfaction with the technology program.[xix] Generally, evaluations need to consider the big picture, but also the day-to-day operations of the technology in the classroom.[xvii, xviii]

Cost

Technology changes rapidly. Providing devices and software in schools requires a large initial and ongoing investment for hardware upgrades, upgraded software licenses, technical support, teacher training, and infrastructure. Although devices have become increasingly affordable, any implementation will cost hundreds of dollars per device. The type of device and software should be dependent on the needs of specific districts, schools, and/or classrooms.[ii,xx] The integration of technology programs require a great deal of attention, time, and money by districts, administrators, and teachers for professional development and training.[ix] Policy- and decision-makers should weigh the cost of a technology programs to determine if the cost is worth any potential academic and/or social outcomes. Due to the high cost and lack of direct evidence of increased learning outcomes for students, some programs and several one-to-one initiatives have been abandoned.[xxi]

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Potential Benefits

Technology programs, particularly device adoptions, have been implemented for several decades in US schools. There is some evidence that students exposed to technology have demonstrated modest growth in technological skills, 21st Century skills, and academic achievement.

- *Technological Skills*
- *21st Century Skills*
- *Academic Achievement*

Technological Skills

Increasing technology in schools offers an opportunity for integration into with curriculum, resulting in gains of general knowledge and ability to use computers, tables and/or other technology. While schools may employ technology differently, students have the potential to use technology to complete assignments, homework, and interact with it in or outside the classroom. As a result of greater contact with and learning how technology work, the technological skills of students and teachers can greatly increase. [ii, xix, xxii, xxiii] The increase of technological skills allows for students to be better equipped as they move through their educational programs and into the workforce. Unfortunately, we still know little about how increased technology skills support student learning across the curriculum and in ways that promote 21st Century.[xxiv]

21st Century Skills

The improvement of 21st century skills is one of the most commonly cited benefits of technology in schools.[xxiii] These skills include critical thinking, communication, collaboration, and creativity.[ii, xix] There is a small amount of evidence demonstrating how technology positively influences 21st century skill acquisition.[v] Interviews, surveys, and self-reported reflections by teachers report that technology initiatives in the classroom increase the critical thinking ability of students and collaborative opportunities.[ii, xii, xxv]

Students and teachers agree that technology initiatives are associated with greater student engagement. Students report they want to be engaged because technology is fun and different from traditional approaches of curriculum delivery.[viii] Teachers report that students appear to be more motivated to learn and more willing to participate in classroom activities.[viii] While student engagement can be hampered by poor security on devices that can cause distractions, teachers report that students often stay on task and are engaged without being distracted.[xii, xxii] Teachers regularly express that consistent access to technology in schools also provides students with an outlet for creativity.[ix] Students can create e-portfolios of assignments, music, videos, and other digital projects on laptops and tablets. Teachers use devices to develop more creative curriculum and provide more diverse options for projects and assignments.[xii, xiii]

Academic Achievement

Limited research identifies small gains in student academic outcomes related to mathematics, writing, and literacy as a result of one-to-one programs. A meta-analysis of the effectiveness of technology on math achievement utilized 74 studies (N=56,886) to investigate K-12 classrooms.[xxvi] The analysis found a positive, but modest impact on mathematics achievement with an effect size of 0.15 compared to traditional methods. The effects varied depending on the type of technology utilized. Students in technology programs in Florida and California outperformed students on state writing tests compared with students who did not participate in the technology programs.[xix, xxvii] In Massachusetts, 60% of teachers responded that a one-to-one program improved students' writing quality.[xxviii] In Maine, eighth grade writing scores improved by one third of a standard deviation over three years after the implementation of a technology program, but reading scores remained the same with no statistically significant change.[xii] In a different report, two years after the implementation of a technology program in Maine, fourth-grade students with regular access to devices scored statistically significantly better than non-users on components of state tests including literary response, analysis, writing strategies, and reading comprehension.[xxv] In a mid-Atlantic state, 6th-8th graders that were part of a one-to-one laptop program did not demonstrate significant increases in

math achievement.[ix] Students in California with devices statistically significantly outperformed students without devices on state math tests.[xxv] In general, among technology programs in the classroom there was a positive, yet small effect compared to traditional teaching methods. [xxv] In Texas, students that had access to laptops had higher reading scores than non-laptop users, but the difference was not significant. An evaluation of the Texas Technology Immersion Project found that among middle school students in a one to one program, the already high achieving students demonstrated higher test scores.[xxix] Due to differential outcomes as related to socioeconomic status of students some researchers have suggested that laptop programs may increase disparities between low and high achieving students.

Challenges to Evaluating Outcomes

While the benefits for technological skills and 21st Century skills is more clear, the evidence presented above suggests modest impacts on student achievement as a result of implementing technology programs. There are numerous challenges to effectively evaluating technology programs. States, districts, and schools have introduced computers in schools and classroom only in the past couple decades. In that time, technology in hardware and software has evolved quickly. Flat screens replaced bulky monitors; wired networks were transformed into wireless networks; software has become more interactive, advanced, and integrate with hardware; and laptops and tablets have replaced desktops. Rapidly changing technology and poor program goals

make it difficult to effectively evaluate the outcomes associated with technology in the classroom and schools. In addition, many evaluations are limited to a single school district, face many methodological issues, or fail to capture the direct effect of technology on various outcomes due to implementation fidelity or availability of data. For example, it is very difficult to adequately account for and measure the effectiveness of technology programs because there are numerous confounding factors that can contribute to the academic success of a student such as environmental, familial, and non-school related resources.

Conclusions

Research on technology in schools is still in its infancy and there are not clear outcomes (positive or negative) as a result of initiatives. Despite this, research has been instructive in providing guidance for the development and implementation of large-scale technology initiatives. The findings in the OECD report is consistent the conclusions of this report. Policymakers need to seriously consider whether an investment in costly technology programs such as one-to-one programs will result in the educational outcomes desired. As this brief outlines, any technology program should be well planned out with clear goals, communication strategies, infrastructure, training, curriculum integration, and adequate funding. Finally, technology initiatives need to be evaluated to understand the direct impact of technology on program goals such as academic achievement, 21st Century Skills, and social skills.

Additional Resources

NCSL Education Bill Tracking Database (Select "Educational Technology")
http://www.ncsl.org/research/education/education-bill-tracking-database.aspx

NCSL Technology and Digital Learning
http://www.ncsl.org/research/education/technology-and-digital-learning.aspx

Learner at the Center of a Networked World
http://csreports.aspeninstitute.org/Task-Force-on-Learning-and-the-Internet

Educational Commission of the States: Technology
http://www.ecs.org/html/issue.asp?issueid=132

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[International Society for Technology in Education](http://www.iste.org)
http://www.iste.org

[Connected Learning Alliance](http://clalliance.org)
http://clalliance.org

[Alliance for Excellent Education's Center for Digital Learning and Policy](http://center.all4ed.org/site/default.aspx?PageID=1)
http://center.all4ed.org/site/default.aspx?PageID=1

Utah Education Policy Center

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Endnotes

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