Securing a Learning Return On Your Educational Technology Investment: A Teacher's Guide to Applying the Lessons Learned from Research

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Research demonstrates that integrating technology into the curriculum can raise student achievement and increase motivation to learn. Because of that, schools have purchased computers and other new technologies, and teachers are being encouraged to bring technology into their classrooms and make it part of their curriculum. But, knowing what to do with that technology in order to ensure that students truly benefit from its use can be confusing and intimidating. What are the most effective and efficient ways that you can move your classroom into the technological era, and how exactly can technology and the core curricula work together?

WestEd RTEC recently released a paper called *The Learning Return on Our Educational Technology Investment* that seeks to answer these questions and offers some suggestions to help ensure that students and teachers get the maximum benefit from technology. Issues such as integrating technology and instruction, teacher training, instructional technology support, access to technology, and long-term planning are addressed. A full copy of the paper is available at http://www.wested.org/cs/wew/view/rs/619.

The paper highlights ten lessons learned from the research that answer the question, "Under what conditions does technology have the most benefits for students?" We have summarized those ten lessons below and have included after each entry some suggestions for how you can apply those lessons in your schools and classrooms.

Lesson # 1: Technology must be matched with learning goals - In order to understand how best to derive benefits from technology, it is important to consider that computer-based technology includes a wide variety of applications and uses. How to get the most from the technology, then, depends in part on what on what you are trying to accomplish by using it. A distinction the authors found helpful comes from the work of Thomas Reeves (1998) who describes learning "from" computers as different from learning "with" computers. In terms of this framework, learning "from" computers occurs when the technology functions essentially as a tutor, as in courseware that offers mathematics or science drill and practice, or provides phonics lessons. By contrast, students learn

"with" computer-based technology when they use the technology as a tool for problem-solving, conceptual development, and critical thinking, as in Internet-based research, creating multimedia as part of a project-based curriculum, etc.. While both these uses of technology are important, learning "with" technology goes farthest toward the development of higher order thinking and the ability to apply what is learned in different situations.

- Identify and include computer applications as part of your regular units in Social Studies, Language Arts, Math, Science, etc. Research, simulations, data bases, and spreadsheets are wonderful ways to introduce students to technology and are truly useful tools for much of their schoolwork.

Lesson #2: Technology is only one piece of the puzzle – Technology by itself will have little impact without accompanying reform at the classroom, school, and district level. Studies of IBM's Reinventing Education program showed that students' reading skills improved in tandem with technology use in schools where the leadership had committed to a school reform plan with clear, meaningful educational goals. In contrast, technology has been shown to be less effective when learning objectives are unclear and the focus of technology use is diffuse (Schacter, 1999).

- Include computer use where it is truly advantageous and will help in getting content across effectively and efficiently. Some tasks take much longer when technology is used, and using technology for technology's sake alone can actually thwart your learning goals.
- Build competencies systematically, not piecemeal. Think about a progression of scaffolded technology skills you want your students to learn and about how those skills work with your curriculum.

Lesson #3: Adequate and appropriate teacher training is vital - A variety of studies indicate that technology will have little effect unless teachers are adequately and appropriately trained (Office of Technology Assessment, 1995; 2000). Until teachers feel adequately prepared to integrate technology with their instructional program, technology will not be seen as an instructional resource. Research has shown that teachers who are more knowledgeable about the use of computers use them more frequently and in a greater variety of ways. They are also more likely to have their students use technology in tasks that require higher-order thinking. In a paper discussing the cost, utility, and value of technology, Wahl (2000) suggests that organizations should spend 30 percent of their budget on equipment and 70 percent on the "human infrastructure" to support ongoing training and technical assistance.

- Take courses and workshops with colleagues. Attend conferences, visit other schools, participate in online professional development events. Above all, get involved and excited about technology yourself, and your students will almost certainly "catch the fever."
- Ask your administration to schedule professional development that addresses your needs to learn about technology and technology integration. Ask tech-savvy colleagues for help.

Lesson #4: Changing teacher beliefs about learning and teaching with technology is an integral part of the process - Integrating technology into instruction is a difficult, time-consuming process. Only those teachers who believe that technology use will lead to significant benefits for their students will undertake the associated challenges. Teachers need time to observe for themselves the impact of technology use on learning and teaching in their colleagues' classrooms, and they need to work with models and mentors who can help them with the change process. ACOT researchers believe that the shifts in teachers' beliefs occurred when teachers began to see firsthand the benefits of technology use (Sandholtz et al., 1997).

- Start modestly with clear goals and simple products and projects.
- Ask your administration for time to visit colleagues classes, reflect on what you see, share, evaluate and redesign your lessons and plans together.

Lesson #5: Sufficient equipment: An adequate computer-to-student ratio should be determined - Without sufficient access to technology, of course, even well-trained, highly motivated teachers will not be able to integrate technology effectively into instruction. A RAND study (Glennan & Melmed, 1996) of technology-rich schools suggested that the most successful of these schools had a high density of computers and high access to them. While there is no magic number, research suggests that a student computer ratio of 5:1 or 4:1 will provide the level of access needed to attain the level of use where technology can best affect student achievement.

- Don't wait until your individual classroom has reached the ideal ratio to start using computers in your classroom. Arrange with colleagues to share computers to achieve the 5:1 ratio, then pass the computers on to the next teacher.
- There are ways to get more computers if you just don't have enough. Lobby the administration and the school board. Seek donations and cheap refurbished units. Get parents involved in the crusade. It can happen.

Lesson #6: Accessible equipment: Classroom access is best – In a study in West Virginia, researchers found that students who had access to computers in their classrooms showed more improvement in basic skills than those who received instruction in computer labs. In addition, teachers who had computers in the classroom reported greater confidence and competence in using computers and spent more time using them. (Mann, 1999). Finally, classroom connectivity to the Internet was found to be the best predictor of teachers' professional use of technology, and connectivity with four or more student computers was found to be the primary determinant for whether teachers directed student research involving the Internet (Sivin-Kachala & Bailo, 2000).

- Insist on locating computers in the classrooms and on having Internet access. Again, lobby the administration and the board and mobilize parents to do the same.
- You can also revamp the lab schedule to flexible, rather than block scheduling. This will give you time to complete larger units of work that integrate technology.
- You don't have to be an expert or a 'computer teacher' to integrate technology in your curriculum. If you have them in your room already, start using them for modest, integrated activities – you'll get immediate payoff.

Lesson #7: Computer access at home holds great benefits - Not surprisingly, students who have computers at home do better than students who don't. A New Jersey study focusing on seventh, eighth, and ninth graders, showed that students who had sustained access to technology (i.e., access at home and at school), as well as email and the Internet did significantly better on standardized writing tests than students who had access to similar technology only at school.

- Don't wait until your students have 100% home access to assign technology work as part of their homework. You can still give technology assignments, while allowing for non-technology alternatives for those students without home access.
- Talk to your administration about allowing students after-school access to computers if they don't have them at home.
- Encourage students to use the local library for computer access.
- Home access can also be provided via battery operated keyboards and Personal Digital Assistants (PDA's).

Lesson #8: Long-term planning is the first step - Research suggests that technology should be implemented only after a planning stage in which administrators and other stakeholders develop clearly articulated standards and goals and a clear vision of how the technology is to be integrated into the mission of the school or district. The most successful schools in IBM's Reinventing Education program were willing to allocate time and other scant resources for planning how best to use the technology to improve instruction (Trotter, 2001).

One common and costly mistake made by schools and districts when developing school budgets is to fail to take into account the ongoing costs of maintaining, supporting, and replacing computer equipment. In some schools, printers sit idle because money was not budgeted to replace ink cartridges, toner, or paper. Schools and districts who spend most or all of their technology funds on initial purchases of software and hardware can end up with no means of supporting those purchases.

- Don't leave the planning up to the administration alone, let your needs and vision be known and volunteer to participate in the planning. Speak up for exactly what you'll need to operate for the year.

Lesson #9: On-site technical and instructional support must be provided - Although adequate access to technology is a key factor in successful implementation, researchers have also found that a major barrier to technology use is the lack of technical support. Even teachers who enjoy using computers will stop using technology if the equipment is unreliable. Many teachers lack adequate troubleshooting skills — not to mention time — to fix equipment, especially if it breaks in the middle of a lesson. The ACOT project found that the most crucial determining factor for whether teachers successfully integrate technology into their classrooms was the level of support they received from school and district administrators. The effective use of technology requires an adequate school and district infrastructure and must include timely, on-site technical and instructional support.

- Again, speak up. You should not be expected to fix and service computers. Let the administration and school board know what kind of support you need in order to provide the best instruction for students and to follow through on your technology integration plans.
- Encourage your principal to allocate instructional aide time to provide on-site technical assistance

Lesson #10: Technology needs to be integrated within the curricular framework –To use technology effectively, teachers must understand how its use fits into the larger curricular and instructional framework. The ACOT study found that student engagement remained highest when technology use was integrated into the overall curricular goals, rather than being an "add-on" to an already full curriculum (Sandholtz et al., 1997). The best courseware (software designed to be used in an educational program) will reflect curricular standards, take into account research on how students learn, and will promote both concept and content learning. (Coley et al, 1997 and Silverstein et al, 2000).

- Map out your major standards-based units and identify key activities and software that enhance each unit particularly well. Do this as a department or with colleagues who have more technology experience. Sustaining this model of integration is the key, so start out thoughtfully and simply, and move at your own pace.
- Start slowly. Develop one unit at the first of the school year and a second one for the Spring.

Technology can be an extremely beneficial part of your students' learning experiences. But, for that promise to be realized, it is important to put together all ten pieces touched upon in this paper. By working with other teachers, parents, students, and administrators, you can secure the necessary attention, funding, and adjustments needed to implement and maintain an integrated technology program in your classroom and school. Computer-based technology can play a significant role in contributing to positive, productive learning for your students. It can also provide an exciting, effective pedagogy for you to employ and can result in a rewarding new direction for your professional practice.

A solid learning return on our technology investment is certainly within your reach. Knowing what works and following the guidelines revealed by the research is the first step toward collecting that return.

Additional Resources for ideas and inspiration to help you integrate technology into your curriculum:

Curriculum

pblnet.org – http://www.pblnet.org

Kathy Schrock's website - http://school.discovery.com/schrockguide/

DiscoverySchool – http://school.discovery.com/clipart

Professional Development

*CLRN (California Learning Resource Network) – http://www.clrn.org

*California Technology Assistance Program (CTAP) Region 3 – http://www.ctap3.org/

Capitol CUE – http://www.capcue.org/

*Technology Information Center for Administrative Leadership (TICAL) – http://www.portical.org

*CTAP Online *Professional Development* – http://www.ctaponline.org

The Technology Toolkit – http://www.wested.org/techplantoolkit/

General Information

*The George Lucas Education Foundation (GLEF) – www.glef.org

Tech Assistance

Tom's Mac info. Technical Resources for K-12 Support Professionals- http://www.tomsinfo.com

Barnes & Noble.com Professional, Technical & Business Bookstore – http://www.fatbrain.com

The Design Gallery from Microsoft – http://dgl.microsoft.com/

* Partner of the Regional Technology in Education Consortium (RTEC) at WestEd.