Securing a Learning Return On Your Educational Technology Investment:
A Principal's and Administrator's Guide
To Applying the Lessons Learned from Research

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Schools have purchased computers and other new technologies in response to claims that integrating technology into the curriculum will raise student achievement and increase their motivation to learn. With so many schools engaged in bringing technology into the classroom, the question arises, "What do we need to do to maximize the return on our technology investment?" WestEd RTEC recently released a paper called *The Learning Return on Our Educational Technology Investment* that seeks to answer this question. The paper offers some suggestions related to issues like teacher training, access to technology, and long-term planning that administrators should seriously consider as they seek to enhance student learning through technology use. A full copy of the paper is available at http://www.wested.org/cs/wew/view/rs/619.

The paper highlights 10 lessons learned from the research that address the question, "Under what conditions does technology have the most benefits for students?" We have summarized those 10 lessons below and have included after each entry some suggestions to help you apply those lessons in your school or district.

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.

- Use computers in support of your core, standards-based curriculum, don't just use computers to teach about computing.
- Encourage teachers to use technology for complex learning tasks, not only for drill and practice.

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).

- Competence with technologies requires a clearly-articulated and scaffolded set of skills and activities that will take time to develop and build. Too many programs use a scattergun approach, assuming wrongly that any time spent on computers is time well-spent. Technology integration should be thoughtful and intentional – computers aren't babysitters or rewards.

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.

- Training cannot be a one-shot and one-size-fits-all workshop. Teachers need repeated access to support and expertise as they incrementally build their own competence and confidence.
- Don't shy away from budgeting the money, time, and human resources needed to get your teachers the on-going, professional development they need.

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 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).

- Encourage "baby steps" first – modest projects that can be observed, evaluated and shared. Provide the time for reflection, sharing, evaluation and program re-design. Assure your teachers that it's OK to make mistakes and that they can grow from them.
- Try to find mentors from other schools who can encourage and guide your teachers along the way.
- Encourage teachers to develop means of documenting the benefits of technology use for their students. This can be a great source of inspiration to themselves and other teachers (and a reminder of why the process is worth the effort in more challenging times.)

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.

- Situate your computers inside classrooms, don't isolate them in computer rooms.
- Get the required number of computers for your school, and remember to budget for maintenance and support at the same time. Talk to your school board about the importance of computer integration and bring along parents and teachers to help make your point.

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).

- Get wired; there's just no way around it. You can probably find parent and community volunteers to help with the process.

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.

- Encourage teachers to include computer assignments to be done as homework, with non-technology alternatives for students without home access.
- Give after school computer access to students who don't have computers at home.
- Start now sending the message to parents and teachers that drawing on home resources can greatly enhance student learning.

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.

- Budget wisely and make your needs known to the Board. Learn from mistakes made elsewhere.

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 in 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.

- Let the school board know what kind of support you need in order to build, maintain and upgrade your technology program. Build a coalition of parents and teachers who support your vision and will appeal to the board for support alongside you.

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 school curriculum, 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 concept and content learning. (Coley et al, 1997 and Silverstein et al, 2000).

- Start by identifying a few, key places in your core standards-based curriculum where technology can enhance learning, and obtain the software resources to support those activities. Talk to other schools and districts who have successfully integrated technology into their programs and ask for advice and guidance.

For technology to contribute positively to the learning experience, it is important to put together all ten pieces touched upon in this paper. This can only be accomplished with the active support and assistance of administrators at the school and district levels in concert with a unified team of teachers, parents, and students. By putting these pieces in place — and with ongoing attention, funding, and adjustments when needed — computer-based technology can play a significant role in contributing to a positive, productive learning experience for students. It can also provide an exciting, effective pedagogy for teachers to employ and can result in a rewarding new direction for their practice.

An educational plan that includes technology integration and the infrastructure needed to implement and support it is well- situated to promote the kind of learning that will help students meet the challenges of the 21st century. A solid learning return on our technology investment is certainly within reach. Knowing what works and following the guidelines revealed by the research are the first steps toward realizing that return.

Other resources and websites to help you with technology integration in your schools and districts:

Technology Planning

The Technology Planning Toolkit - http://www.wested.org/techplantoolkit/

Tech Support

*TechSETS – http://www.techsets.org

Michigan Technology Staffing Guideline, Worksheets for calculating the level of tech support a school district will need – http://techguide.merit.edu/

Professional Development

The CEO Forum Reports: 1) School Technology and Readiness, 2) Professional Development: A link to better learning – http://www.ceoforum.org/reports.cfm

*California Technology Assistance Project (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

Hardware

C-SMART – http://www.c-smart.org

The Software and Information Industry Association, offering guidance about accepting donated computers – http://www.siia.net/divisions/education/donatecomp.asp

Software

CalSAVE – http://www.calsave.org/

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

*Sun Microsystems – http://www.sun.com/staroffice/

Total Cost of Ownership

Consortium for School networking: Taking TCO to the classroom – http://www.classroomtco.org/

Technology Standards

The International Technology Education Association, Technology for All Americans - http://www.iteawww.org/C.html

The National Educational Technology Standards(NETS) for Administrators - http://cnets.iste.org/tssa/

General Information

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

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