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Over the last 20 years, K-12 schools have spent millions of dollars equipping their schools with the latest technologies, but often without a thoughtful plan of how their use would impact learning and teaching. Computers, like other technologies when they were new--such as radio, television, motion pictures, and video--were expected to substantially change education simply by making it more exciting and interactive.

But technology use is not about the hardware, Internet connections, and so on. What is

important is how the technology is integrated with the instructional program. The guiding question technology leaders must keep in mind as they develop their plan is, "Are students using technology in ways that deepen their understanding of academic content and advance their knowledge of the world around them?" (When we use the word "technology," we refer to more than computers. Technology includes the whole array of new technologies including, video, digital cameras, handheld computers, cell phones, and other devices still in development.)

To ensure that technology dollars have an impact on students, staff, and the community, districts and schools must develop a thoughtful technology plan. Technology plans that help districts and schools to use technology effectively include all of the ten steps that follow.

1. CREATE A VISION

Vision is the first step for technology planning. The district or school must have a picture of what a technology-enhanced program will look like in three to five years. Vision statements are compelling stories that describe how students will be using the technology and how teachers and other staff will be using it for data-driven decision making, increased productivity, and planning. A vision also includes how the learning environment will be enhanced to support technology use.

2. INVOLVE ALL STAKEHOLDERS

For any plan to be effective, all stakeholders should have the opportunity to have an input into the goals of the plan. Teachers, administrators, other employees, parents, and the general community all have a stake in the educational outcomes of students.

3. GATHER DATA

You must understand where you are in order to plan for the future, so gather as much data as possible about your present use:

* Conduct an inventory to determine what equipment and software you presently have and where it is located (labs, classrooms, library/media centers, and so on).

* Determine the present level of use in your classrooms. There are multiple ways to collect this information. One is to survey staff and student use by asking about both their skill levels and how teachers and students are using the technology. Develop your own survey or adapt one developed by another district. There are also several online assessments including, enGauge, available at http://www.ncrel.org/engauge/. The

enGauge framework identifies six essential conditions critical to the effective use of technology for student learning. Another resource is the Learning with Technology Profile Tool, available at http://www.ncrtec.org/capacity/profile/profile.htm. This computer program presents indicators of engaged learning and indicators of technology. For each indicator there are three choices that educators can compare to their own practice. When finished, educators can view the results in a graphical format to help identify their strengths and weaknesses.

* Gauge the progress your school is making to improve student achievement. The Annenberg Foundation http://www.annenberginstitute.org/accountability/toolbox/) has gathered together a set of Tools for Accountability to help. Each drawer within the Toolbox offers descriptions, examples, and specific in-school experiences to guide the many members of a school's community.

* Conduct site visits. It may be desirable to visit schools that demonstrate compelling reasons for using technology. This is particularly important if your school uses computers mainly for word processing and drill and practice. If your planning team has never seen student use of multimedia, digital video, or student web pages, it will be difficult for them to envision these uses. Visits can help to open one's mind to the possibilities.

4. REVIEW THE RESEARCH

Knowing what the research says about the use of technology is important to guide your technology planning efforts. Research has found that some technology use impacts student learning while others make no difference (Dwyer 1994; Butzin 2001). The research on technology's effectiveness is divided into two areas: (1) learning with computers, using computers as tutors (most often drill and practice) and (2) learning from computers, which is when the student uses the computer as a tool in the learning process for communication, collaboration, research, or publishing.

A summary of the research (Kulik 1994; Butzin 2001; Mann 1999) for both types of use finds that technology can impact student learning when the following conditions are evident:

* Students have easy access to the technology.

* Technology is in the classroom, where it can make a greater impact then when it is in labs.

* Ongoing teacher training is provided.

* Reform of teaching practices is evident, with a balance between traditional instruction, characterized by teacher lecture, and that of construction, characterized by the teacher serving as a guide and facilitator.

* The software is well matched with the teacher's assessment of student needs and the objectives of instruction.

5. INTEGRATE TECHNOLOGY INTO THE CURRICULUM

As the research demonstrates, technology impacts student learning when there is a match between content standards and the technology being used. Teachers face six barriers to effectively integrating technology with their curriculum:

* Leadership. The lack of leadership is the single biggest barrier to the use of technology.

* Access. One or two computers or a weekly visit to a computer lab do not impact student learning.

* Time. It takes time for teachers to review software and figure out how it fits with their instructional program.

* Cost. Schools often provide only minimal funds to purchase software. Teachers may not be willing to spend their own money to purchase multiple copies of software.

* Training. Apple Classroom of Tomorrow (ACOT) research found that it takes training for teachers to move from "How do I turn it on?" to where they comfortably and routinely integrate technology into their classroom.

* Reform. Technology makes its greatest impact when teachers use project-based learning practices to engage students.

Student proficiency standards embedded with instructional projects can help teachers to know which technology skills students need to demonstrate. The NETS project offers one model (http://cnets.iste.org/index2.html).

6. COMMIT TO PROFESSIONAL DEVELOPMENT

The plan must address the goals for professional development. Providing appropriate training is the key to effective use. Research has demonstrated time and again that an ongoing professional development program is required (Dwyer 1994; Ringstaff et al. 1991; Ringstaff 2001). The most effective staff development programs deliver to teachers when they need it, at their school, and on their own equipment. One-time "spray and pray" workshops do not result in any change in teacher behavior. The ACOT research found that teachers' growth goes through five stages: entry, adoption, adaptation, appropriation, and invention. Even with a strong professional development program, less than 50 percent of teachers reach level three.

The plan should also address the technology proficiencies that teachers will be expected to demonstrate. The NETS Project, mentioned earlier, can also be a source for teacher proficiency standards if your state or district doesn't have them.

7. ENSURE A SOUND INFRASTRUCTURE

For technology to impact student learning, the technology plan must ensure that appropriate resources are in place to support and maintain networks and equipment. Technical support is also essential so that all systems work 24/7. Techno-phobic teachers will quickly give up on technology use when it doesn't work after they have spent many hours learning about the software and planning technology-enhanced lessons.

Setting single standards for software, hardware, networks, and video equipment is crucial. Doing so will result in significant savings in staff development and support costs, including repairs, and will make it easier to upgrade and support district licenses. Technical support may be a nightmare otherwise, because incompatible systems can't "talk" to each other.

8. ALLOCATE APPROPRIATE FUNDING AND BUDGET

The plan should be in line with your district or school's financial resources. It should not promise more than the budget can deliver.

There are two parts to a technology budget. A recommended formula for the first portion is as follows: 40% of every dollar allocated should be for hardware, 20% for software, 20% for professional development, and 20% for upgrades and additional needs as teachers' expertise grows. If you spend all of the money on hardware, you will not see the return on student learning because there will be no funds for professional development, upgrades, and so on. These recommendations are not just for the first year, but for anytime you budget or receive one-time grant dollars.

Budget separately for technical support expenses. Support must be available 24/7 so that teachers have confidence that the time they spend in reviewing software and planning will not be lost when equipment and networks fail to work.

A thoughtful technology plan will not consider the purchase of more hardware and networks then the district can support with its technical support capacity.

9. PLAN FOR ONGOING MONITORING AND ASSESSMENT

The plan must address ongoing monitoring and assessment. Plan to collect data using rubrics, student artifacts, surveys and tests. Develop benchmarks and timelines for all components of the plan. Some questions the plan should address are:

* Is the technology being used effectively?

* What elements are missing?

* What needs to be added?

The plan should address how the results of this assessment will be communicated to all stakeholders.

10. PREPARE FOR TOMORROW

While planning for today, keep an eye on tomorrow by allowing for new and promising practices and technologies. Remember back ten years ago when "www" didn't mean the World Wide Web, laptop computers were big and called "luggables" by those who owned them, and when 48 k and a 24-baud modem were fast?

Would you have predicted back then the hardware, networks, and software you Have in your schools now? Probably not. Ten years from now will computers even Look like the computers we use now? How will Personal Digital Assistants (PDAs) And other handhelds change the way we organize and learn? And, finally will we All be totally wireless, able to communicate at anytime, anywhere?

In preparation for the future, set some funds aside to encourage teachers to try new applications and determine what value, if any, these applications have for your program before you purchase items only a techie could love.

Technology can improve teaching and learning when a school or district develops a plan that incorporates these essential elements and provides appropriate funding to make its vision a reality.

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OTHER SUGGESTED RESOURCES

* Apple Classrooms of Tomorrow (ACOT) (http://www.apple.com/education/k12/leadership/acot/library.html)

* ACOT was a research and development collaboration among public schools,

universities, research agencies, and Apple Computer, Inc. Initiated in 1985, ACOT began its work in seven classrooms that represented a cross-section of Americas elementary and secondary schools. Its goal was to study how the routine use of technology by teachers and students might change teaching and learning.

* Apple Technology Planning Guide (http://www.apple.com/education/planning/) The Planning Guide is a tool designed to assist you in creating and implementing a technology integration plan for your school or district.

* Project CHILD (http://www.ifsi.org/child.htm) A computer-integrated instructional system for grades K-5. Project CHILD enables elementary schools to effectively use technology along with best teaching practices. he focus is on reading, language arts, and mathematics.

* Technology Planning Toolkit

(http://www.wested.org/tie/techplan)

* Provides rubrics, checklists, and other guides for planning technology implementation.

Where appropriate, links are provided to other sites that offer models of best practice, example plans, and additional tools and resources to support a more informed technology planning program.

* The Guiding Questions for Technology Planning (http://www.ncrtec.org/capacity/guidewww/gqhome.htm) Designed to help begin a technology planning process, select a planning model, and move the process forward. It is considered most useful when it is used within a larger planning process and not simply as an add-on or one-time discussion.

* West Virginia's Basic Skills/Computer Education program (http://www.mff.org/edtech/projects.taf?_function=detail& Content_uid1=151) This study examines West Virginia's long-running Basic Skills/Computer Education program and its positive impact on students' standardized test scores. West Virginia has had across-the-board increases in statewide assessment scores in all basic skills areas, and their NAEP (National Assessment of Educational Progress) scores have risen.

ABOUT THE AUTHOR

Harvey Barnett is a Senior Research Associate in the Technology in Education program at WestEd. He has served as a consultant to state departments of education for technology planning and policy issues. He has also served as principal of Stevens Creek School in Cupertino, California, one of the first Apple Classroom of Tomorrow (ACOT) project schools in partnership with Apple Computer Inc., and as Director of Technology for the Cupertino School District. (E-mail: harveybarn@aol.com)

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