

● Preparing Teachers for the Challenge ● of Teaching and Learning with ● Technology: Standards, Strategies, and Statistics

Karen I. Adams and Pamela Petty

Teachers and Technology

Research indicates that teachers must use computers competently in their classrooms, both as vehicles of pedagogically sound instruction and for classroom management. They must have knowledge of hardware and software applications (Hardy, 1998; McNamara & Pedigo, 1995; Siegel, 1995; Walters, 1992). However, Rosenthal (1999) cites a survey done by the National Center for Education Statistics (NCES 2000–003) finding that only 20 percent of the nation’s 2.5 million public school teachers feel comfortable using technology in their classrooms. Another recent NCES brief (2000–090) elaborates that 13 percent of all public school teachers with access to computers or the Internet at school feel not at all prepared to use technology, 53 percent feel somewhat prepared, 23 percent feel well prepared, and 10 percent feel very well prepared. These findings underscore other research (Siegel, 1995; Schrum, 1999; Strudler & Wetzell, 1999) which indicates that even if teachers hold positive attitudes toward technology, the lack of time, access, and support needed for them to feel competent using technology in instruction may keep teachers from becoming comfortable with technology in their classrooms.

Poole and Moran (1998) suggest that limited and/or inadequate staff development prevents teachers from utilizing existing technology in their teaching. The authors elaborate by asserting that “One-shot workshops, added expense of training, lack of continued support, isolated knowledge, unawareness of school needs, lack of knowledge and support from leadership all contribute to the ineffectiveness of technology staff development” (p. 60). More continuous training in the use of technology in education over the course of at least seven years may provide teachers with the experience,

● **Karen I. Adams**, former Dean of the College of Education and Behavioral Sciences at Western Kentucky University in Bowling Green, is currently Dean of College of Education and Human Services at Central Michigan University in Mount Pleasant.

Pamela Petty is an Assistant Professor in the Department of Special Instructional Programs at Western Kentucky University in Bowling Green.



comfort, and confidence to successfully incorporate technology into instruction (Hardy, 1998). Thus, sequentially planned, long-term professional development is necessary to ensure change.

Braun (1993) underscores the types of technology training teachers need as he reports conclusions drawn from research conducted by the International Society for Technology in Education (ISTE): “Teachers need training in the uses of technology in their curricula; time to develop these uses; and support from their administrators in a risk-free environment—and they need these on a continuing, long-term basis.” While many people recognize the need for staff development related to technology, Bailey (1997) nevertheless asserts that “even though there is considerable information about the general characteristics of effective staff-development practices, there have been minimal amounts of information specific to technology staff-development programs” (p. 58).

Wang (2000) utilizes a model published by Lloyd and Welliver (1989) denoting familiarization, utilization, and integration as three phases that provide a framework for computer training for teachers. The focus of the familiarization phase rests on acquainting teachers with computer equipment and terminologies. The utilization phase of instruction involves teachers using computers as personal production tools. Direct integration of technology into the curriculum occurs in the final phase of training. McNamara and Pedigo (1995) discuss a similar training model that follows three basic levels: awareness level, which provides basic knowledge about computers; development of skills level, actual use of equipment and computer software; and application level, integration of computers into curriculum.

Teachers need models to follow when integrating technology into the curriculum. Sherry, Billig, Tavalin, and Gibson (2000) suggest that teachers need mentors, specialists who help guide their understanding of technology, and online resources available to them as they attempt to use technology in curriculum integration. This support structure provides a level of empowerment to the teachers both as learners and as users of technology.

Thornburg (2000) makes an interesting observation as he notes, “Technology is not the point—learning is” (p. 5). In the author’s reference to technological fluency, he suggests teachers should not stop with students merely knowing how to use computers, but teachers should set examples of how to use computers as tools for learning. Poole and Moran (1998) suggest a staff development model called “Teachers Teaching Teachers Technology” (T-4).

The plan works on the premise that a team effort toward technology training can promote effective technology learning by teachers. Teachers obtain release time for working to integrate technology into their curriculum and for developing personal technology skills. A team of “experts” from within the school surveys teachers for training needs, develops a training schedule of classes, and serves as instructors in those classes. The teachers trained in the initial classes serve as the next level of “experts” when the training session appears next on the schedule.

By contrast, Saul Rockman, as quoted in *Electronic School*, believes that teachers should learn only enough about computers to get their work accomplished (National School Boards Association, 2000). He indicates that students would take the lead in using technology if teachers would move aside and give them permission to do so. The technology gap that exists between students and teachers indicates “students may know more about how to use the technology than adults” (Watson, 1998, p. 1035). In her research on how students use information technologies, Watson suggests the need for more research into how best to assist teachers in using technology to facilitate student learning. *Teachers and Technology: Making the Connection* (1995), developed by the U.S. Office of Technology Assessment, indicates that everyone benefits from student and teacher collaborations in using technology as “the K–12 students themselves learn the technology and help their teachers find ways to use it” (p. 8). This notion underscores a recent survey (National School Boards Foundation, 2000) indicating that three out of four teenagers use online resources.

Weiner (2000) indicates that, based on a survey conducted by Market Data Retrieval, funding spent on teacher technology training constitutes only a minimal amount of the total budget for technology in public schools in the United States. Of the estimated \$5.67 billion spent on technology in public schools during the 1999–2000 school year, only 17 percent went to teacher training.

Preparing Future Teachers

In reference to encouraging teachers to integrate technology into their classrooms, Dr. Linda Roberts, special advisor on technology to the U.S. Department of Education, states, “If you can get teachers to use technology effectively in their own lives, you have won 90 percent of the battle” (Rosenthal, 1999, p. 22). Rosenthal describes how the National Council for Accreditation of Teacher Education (NCATE) requires all colleges



and universities to train preservice teachers in how to effectively integrate technology into their curricula as opposed to only offering separate courses about technology. Brush (1998) concurs with this notion as he calls for integrated technology training throughout the teacher education program. Computing instruction integrated throughout the teacher education program, according to Moursund and Bielefeldt (1999), reigns superior over isolated computer classes. Students who receive computer instruction in an integrated manner more naturally incorporate technology into the school curriculum as inservice teachers.

Wang (2000) indicates that preservice teachers placed in practicum settings with teachers who view efforts to integrate technology into the classroom as hindrances to routine work will not appreciate the value of computers in education. While much research exists relating to understanding preservice teacher perceptions of technology (Diegnueller, 1992), some perceptions of good teaching practices may reflect an obsolete educational system. In a study of preservice teacher perceptions on changing teacher roles and technology, Carr-Chellman and Dyer (2000) asked preservice teachers to respond to a reading on the future vision of education. Results showed that many respondents preferred traditional teacher roles that reflected the same types of teaching methods as they experienced as students. The researchers credit much of this to the way human beings respond to change in general. Traditional teacher roles may fall in line with what teachers expected of the job, so any dissention from that may not align with what they anticipated. Therefore, Carr-Chellman and Dyer's results may not reflect as much about how teachers view technology as they reveal about how teachers view the changes taking place in the education profession.

Technology is changing the way in which schools, colleges, and departments of education prepare teachers and measure their success, both in the means of the measurement used and in the actual performance expectations. Many teacher preparation programs currently require that preservice teachers, in their upper level methodology and content courses, prepare well-integrated Microsoft PowerPoint® lessons, conduct online research projects, participate in Internet-supported projects linked with students in elementary or secondary classrooms, and demonstrate the ability to integrate technology appropriately into lesson plans designed to maximize students' learning. Subsequently, these programs often expect students to prepare and maintain electronic portfolios and then encourage graduates to register online for possible teaching positions. At the core of these changes in expectations

regarding teachers' preparation and performance are several questions: How have actual classroom instruction and student learning changed as a result of technology? How should learning now be different? How can we measure this difference?

The early uses of technology in P-12 and university classrooms were often no more than glittery, fast-paced worksheets on a screen. No new learning actually occurred. Only the medium of instructional delivery had changed and become, for some, more enticingly packaged. The opportunities for productive applications of technology are quite different today. Interactive computer-based writing labs allow students to read, question, and critique one another's essays in a way that traditional classroom writing processes never allowed. Science lab simulations permit students to conduct experiments and to measure results individually or in small groups without expensive or potentially unavailable labs.

Internet bookstores and news sources provide students and teachers with current author interviews, book reviews, and the opportunity to discuss bestsellers with readers throughout the world. Oprah Winfrey has done more to produce an enthusiasm for book chats among American adults than four years of high school literature response groups ever accomplished. Even with the demise of Oprah's Book Club, *Good Morning America* and Regis and Kelly have followed her example and begun book clubs spotlighted on their television shows as well as Web sites. Clearly, there would not be these copycat clubs if there were not an audience. Publishers have also taken advantage of public interest in discussing books in a way that never happened so broadly in traditional book clubs. With increased interest in the idea of book clubs, publishers such as Viking Press now often include discussion guides for readers that provide thought-provoking questions for groups to use in reflecting on the content and implications of a book's themes, the author's intent, and the like. How interesting that those old high school essay questions about literature that were once so painful and disagreeable as assignments are now exciting as friends discuss what they have just read.

P-12 Technology-Enveloped Learning, Teaching Effectiveness, and Teacher Accountability

The medium of Web-based technology has drastically changed opportunities to learn. The days of clipping a current events article from the newspaper for a world history class have now been replaced by CNN's instant updates with video clips and on-the-spot interviews.



Technology can indeed open the world to learners of all ages. Daily English language newspapers from Albania to Brazil to Tanzania are readily available to Web users. News media Web sites provide five-day weather forecasts for cities from Timbuktu to Mandalay. No longer tied to quickly outdated classroom maps, teachers can use search engines to display current country and city maps, allowing students to view entire continents as well as to chart their route on the Paris Metro from the Louvre to the Champs Élysées. Sites such as MapQuest® provide door-to-door directions for travel and regularly updated maps of the world. Interactive Web sites allow students to plan a possible weekend of theater and art gallery exhibits in London and month-long train trips through western Europe. *National Geographic's* site offers contemporary and historical articles on world cultures supported by interactive maps, and programs such as MayaQuest allow students to experience adventure travel through ongoing journal entries and video clips from travel throughout the world. Social studies classes can be continuously updated and supported by such increasingly sophisticated Web sites.

Our personal enthusiasm for the enhanced learning that technology can encourage is not for the possibility of fast-paced, entertaining reading and math skill programs but for technology's ability to open the world to learners. At the time of Princess Diana's funeral, CNN provided Internet users the ability to view Westminster Abbey from a complete 360-degree perspective. Students wanting to learn about another country can not only view updated maps but can also read U.S. State Department advisories, check current exchange rates, find typical menus and recipes, and even identify the number and location of automatic teller machines.

While to some this may seem like nonessential, peripheral fluff when compared with increased ACT and SAT scores, an increased knowledge of the world and its resources is essential for the production of an informed citizenry, one of the traditional purposes of the American education system. This is the learning we believe technology can and should encourage. It should *not* be merely an update of the old worksheets and learning strategies. Technology can and should take the student to levels and methods of learning not possible before, providing the opportunity to explore, to interact, and to discuss. Teachers continue to be accountable for students' learning in an increasingly technology-enhanced world, but the breadth of learning that is possible has changed drastically, as should the measures of teachers' accountability. Teachers can now be evaluated not only by the knowledge they impart but also by the appropriateness of the technological

tools they have provided to learners in their classrooms and by their personal demonstrations of the effective use of these tools. The teacher who simply tells a classroom of students to surf the Web for information on a general topic without additional guidance and purpose is no better than a teacher who in the past distributed word search puzzles for students to complete or asked students to fill a morning of instructional time trying to create the most words possible from “Thanksgiving.”

Teachers still need to establish learning purpose and to determine the best means for attaining that desired learning. Technology, however, has increased the number and variety of these best means. Alan Kay, a Walt Disney Fellow in Imagineering, has defined this change by broadening the commonly applied definition for computer literacy. “Genuine computer literacy is not about learning to use tools like a word processor or spreadsheet, but about learning a new language of events, processes, and dynamic relationships that will help make the world and its ideas more understandable, more communicable, and more civilized” (Schmucker, 1999, p. 40). This new definition helps to identify part of the change that technology has brought to teaching; the language and learning processes are now different. While debate continues about appropriate applications of technology, particularly in the area of learning simulations and games intended to re-create reality, the teachers’ role in selecting the best instructional tools is a serious one. Technology is not necessary for all learning, and it may even be detrimental for some. It is, therefore, the role of the teacher to know when it is and is not best to integrate technology significantly in the learning process and, subsequently, what technology to use and how to use it.

The Michigan *State Technology Plan: Update 2000* identifies significant advances because of the transformation of education through technology. Appropriate technology use allows:

- student-centered learning;
- mass customization with instruction to fit individual student needs;
- flexible pacing based on student abilities;
- distributed learning possible from any place and at any time;
- critical thinking in real-world contexts;
- collaboration and dialogue among students and between students and teachers;



- up-to-date primary information resources; and
- parent-teacher communication available daily.

These advances are in sharp contrast to the more traditional, non-technology-supported education that emphasizes learning tied to the teacher, classroom, and school building during school hours, with often out-of-date textbooks and semester-based parent-teacher conferences.

Evaluation of Technology Use and Assessment of Its Impact on Student Learning

The models used for the evaluation of instruction in teacher preparation programs have perhaps become more intricate than in the past. Although evaluators have traditionally looked for accurate material presented in the most effective manner, they now expect to see effective applications of available technology. Teachers must be highly proficient in their understanding of technological applications and available resources lest they be inappropriately impressed with cute-but-unnecessary technology and unaware of the possibilities of emerging applications. The question for the teacher involves what technology, if any, might best support a lesson, accompanied by an understanding of the relative simplicity or difficulty of such technological applications and any additional student preparation necessary to ensure that students learn. In *Technology and the New Professional Teacher* (National Council for Accreditation of Teacher Education, 1997), the Task Force on Technology and Teacher Education succinctly identifies this new role: “Teachers should help students pursue their own inquiries, making use of technologies to find, organize, and interpret information, and to become reflective and critical about information quality and sources” (p. 4).

With the increasing amount of information accessible to students, teachers must not only help students identify information and technology for instructional use but also guide students in evaluating the technology itself and the quality of information presented. The NCATE Task Force describes the new attitude necessary for the teacher who is “fearless in the use of technology, encourages them [students] to take risks, and inspires them to become lifelong learners” (p. 4). Administrators and faculty in teacher preparation programs must respond to this new role for teachers as they rethink their programs and the anticipated knowledge and ability they expect from their students. At the heart of this process is the question, well-phrased by the Task Force: “What knowledge, skills, and attitudes will they [teacher

education students] acquire from the teacher education program that are essential for them to perform successfully in technology-enriched P–12 classrooms?” (p. 10).

In his announcement of the new *Enhancing Education through Technology* program, U.S. Secretary of Education Rod Paige emphasized that “it’s pointless to integrate [computers] into the curriculum if they don’t add value to student performance” (U.S. Department of Education, 2002, p. 3). Gilbert Valdez, deputy director of the North Central Regional Educational Laboratory, identified four “critical factors that influence whether or not technology impacts student learning”:

- the quality of the teacher;
- the teacher’s professional development in technology;
- the alignment of the technology use with curriculum, instruction, and assessment expectations; and
- the strategy behind the use of technology.

Accountability for learning, therefore, is tied to the appropriate selection and use of available resources. This is not a new idea in evaluation, but the available resources have significantly increased. Basic computer skills such as keyboarding, use of search engines, and design of spreadsheets are no longer enough in the area of technology. Teachers must be accountable for their knowledge of technology directly attached to their areas of instruction—how to use it, how to demonstrate its use, and how to evaluate its impact on students’ learning. Teaching about technology will not suffice; instead, teachers must teach with technology imbedded in their instructional planning processes. This in itself is a challenge for teacher preparation programs. These programs face an equally serious challenge, however, in determining how best to measure these new teacher skills and knowledge. What scoring rubric will suffice to evaluate such a prospective teacher?

Some would argue that students need only learn the basics of computer use in P–12 settings, basically a computer literacy course, as preparation for the job market. These critics of the integration of technology into the curriculum would artificially separate technology-rich instruction from traditional classroom content and instructional approaches, but they are ill informed about the possibilities for the contemporary classroom and in fact would do students a great disservice. Their understanding is no different from those who have recently argued for the teaching of synthetic phonics,

teaching letter sounds isolated from actual words rather than in the context of literature and storytelling, to build language use and understanding. Technology separated from meaningful content is as empty and limiting for students as those isolated letter sounds. Employers in all areas of business and industry are seeking employees with good problem-solving skills and technology application abilities. The requisite learning for these abilities cannot occur in an isolated setting of technology for its own sake. They depend on the thoughtful and planned use of technology to enhance learning and to assist in meaningful problem solving. This will be the measure of students' success in grades P–12 and in teacher preparation programs, and it will be the basis on which to measure teachers' success. Summarized succinctly by O'Kelly (2002), "for schools to use technology effectively, it's not just the computer that needs to be taken out of the box."

As a final note of change, many schools, colleges, and departments of education are increasingly involved in an additional application of technology in the preparation of teachers: Web-based courses and instruction. The use of Web-based and Web-supported courses can indeed provide instruction to students whose geographical locations or work schedules may not allow them to take advantage of traditional on-campus class scheduling. This need for a new adaptation of distance learning is especially important as we face an increasing shortage of teachers. These newly developed Web courses should not, however, be the same old worksheets placed on a computer screen as was true of early classroom applications of technology. Instead, meaningful interaction needs to occur through exploration, problem solving, and discussion—the same traditional methods but in a new format. The future will continue to present exciting and challenging applications of technology in the instructional arena, particularly in the area of teacher preparation. Higher education should take the lead not only in the design of instruction but also in the area of evaluation of instruction and subsequent learning that is technology dependent.

Technology Planning at the State, District, and Local School Levels

A 1991 policy statement generated by the Council of Chief State School Officers requires that all states develop and maintain written plans for integrating technology into the education curriculum (1994). Anderson (1996) describes state-level technology plans as more general than district or local school technology plans. The state plans address more nonspecific

principles, financial support, and issues of district accountability of state funding. District technology plans address the specific needs of a school system and include an overview of local school technology goals. District plans provide broad outlines of the many aspects of the use of technology in education including administrative concerns, public relations, and other facets of the school system as a whole. Local or building level technology plans focus on curriculum concerns, teachers, and learners. These plans usually include vision statements and set goals for the use of technology to support the curriculum.

Financial, technical, human resource, architectural, and legal aspects serve as major components of technology planning for state, district, and local schools (Anderson, 1996). “Although technology planning occurs at multiple ‘levels,’ many principles are identical. Planners need to engage the services, creativity, and assistance of all stakeholders” (Anderson, 1996, p. 1). The magnitude of this planning requires people to establish timelines, delegate responsibilities, and constantly evaluate the plans during the building and implementation phases. Peterson (1989) indicates that school board members and district administrators may not know the steps to take in planning for technology in their school systems.

Summary

The new millennium brings with it the evolution of technology-supported teaching and learning and also the incredible potential for educators to take advantage of incorporating that technology into their teaching. A review of the literature indicates that our society will continue to rely more and more on technology. Future generations must possess the skills to use that technology in the work force as well as their personal lives. Governmental, private, and business sectors of our society must recognize the need for schools to help train students and must continue to aid schools financially in their quest for computers and other aspects of technology. Teachers suddenly presented with new and unfamiliar types of technology may or may not readily integrate them into the curriculum as they struggle with inadequate or insufficient staff development.

Current literature related to the use of technology in education provides us with information about how traditional teaching models change with the introduction of computers and other technology. These changes affect technology planning for a school or a school system. Teacher training and professional development for teachers in the use of technology are the



subjects of several ongoing research projects, but to date no consensus exists regarding the most effective model for such training. While the literature provides agreement that integration of technology into the curriculum is paramount, the methods for training teachers to integrate technology and the methods for adapting appropriate pedagogy remain random with a hit-or-miss approach. Colleges and universities face similar challenges in preparing new teachers to readily integrate technology in their teaching.

The literature also indicates that the people responsible for making critical decisions regarding the implementation and use of technology in classrooms often make those decisions without the proper information or background knowledge. States and local school districts make vital and pressing decisions regarding the implementation of technology into classrooms. These decisions must take into account all the stakeholders affected, including teachers, students, parents, administrators, and community members. Understanding the current status of technology use in a school or school system constitutes the first step in making these important decisions (U.S. Department of Education, 1998).



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