CHALLENGES, ADVANTAGES, AND DISADVANTAGES OF INSTRUCTIONAL TECHNOLOGY IN THE COMMUNITY COLLEGE CLASSROOM

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This article takes an historical look at the lessons learned in the 20 years of computer-based technology integration (Valdez, McNabb, Foertsch, Anderson, Hawkes, & Raack, 1999). Interjected are the perspectives of usage during the 15-year implementation within a highlighted school district, including current issues related to their technology plan. Whereas some issues associated with technology use have been evident since its inception, others are just now emerging. By studying the progression from a focus on print automation, to learner-centered approaches, to virtual learning via the Internet, strategies applicable in today's classroom are revealed. The consensus of the accumulated knowledge is analyzed in a look at current challenges and trends.

Technology use finds itself woven into an almost daily educational discourse and debate. It is relatively easy to forget that computer use in education is a relatively new phenomenon that has evolved to widespread use only within the last 20 years. Teachers began to have more control over classroom technology use with the introduction of the first microcomputers in 1997 according to Roblyer and Edwards (2000). Even as technology use and application advances at an almost logarithmic pace, many of the issues related to technology use remain remarkably constant. These include properly trained staff, adequate equipment, ongoing funding, and successful integration of technology in order to maximize learning. Effectively meeting such challenges can magnify the advantages of incorporating technology while diminishing the disadvantages.

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As we anticipate the future of technology use in education, it is helpful to understand how its applications have evolved. Researchers (Valdez et al., 1999), in conjunction with a grant from the U.S. Department of Education, have evaluated three stages of technology implementation. Each stage is examined to validate evidence of positive learning effects and to evaluate its potential impact on current technology decisions related to student learning. It should be noted that these stages overlap and simultaneously continue to valuably function when properly used in educational settings. These findings along with related research give us a better understanding of lessons learned about best practices for technology integration.

LESSONS LEARNED FROM THE BRIEF HISTORY OF COMPUTER TECHNOLOGY USE

Print Automation of the 1980s

The first phase, classified as print automation, dominated the 1980s. It is helpful to recall the limited capabilities of personal computers. The average memory was 16,000 bytes as compared to 128,000,000 or more today. The Apple IIe computers used in our local school district were representative of those commonly used. In three years of observing teacher computer use, it was surprising to see the frequency with which computers were unused in the corner, sitting idly as a wasted resource. Reasons given at the time were lack of technical knowledge on the part of the teacher and difficulty in integrated activities for one student that did not interfere with the flow of instruction to the group. In retrospect, these challenges make sense in light of the fact that the print automation technology phase was notable for its emphasis on individualized self-contained lessons. It was logistically challenging to separate one student while the others received instruction in a traditional manner.

Although in-room computers may have been underutilized, teachers generally took advantage of the opportunity to send groups of students to the computer lab. These labs generally consisted of five or six computers located in a hallway, storage area, or resource room corner. Usually a software package would be introduced and demonstrated by the computer specialist as a whole class lesson. During the following weeks, about five students would be sent to the lab on a rotating basis during the one half hour per week allotted each class. As teachers’ roles were often relegated to “finding time in the day to send students to a computer lab for drill and practice or electronic tutorials” (Valdez et al., 1999, p. 2), it is not remarkable that many teachers found lab
time sufficient and disregarded the computer that sat in the classroom corner.

Furthermore, there were not enough computers to allocate one to each class. When class sizes of about 25 students are taken into account, each student may only have computer exposure on average once per month, unless an in-class computer was accessed in the interim. Thus, even when early efforts were made to expose students to technology, actual usage per student was minimal. A result of this was an obvious disparity in the level of technical experience by students who received opportunities at home compared to the majority who did not.

This first phase of computer use can be characterized as a behavioral learning approach “based on Skinner’s methods of branching: dividing into small units, rewarding collective responses, and teaching discrete facts” (Valdez et al., 1999, p. 5). The advantage of this approach is individualized self-paced instruction targeting specific skill deficiencies that still has positive applications today especially in the at risk populations who need remediation. In these applications it is critically important for educators to evaluate the software to ensure that educators—as opposed to strictly programmers—were involved in its development. Toward the end of the first phase a more cognitive approach began with an emphasis on problem solving.

Researchers found evidence that the success of computer-assisted instruction was greatest in structured content areas such as math (Valdez et al., 1999). In summary, the computer-assisted instruction foundational to the first phase of technology use has relevance today especially when “the software, the purpose for instruction, and the learning objectives match teacher’s understanding of learner’s needs to memorize and respond to predetermined answers” (Valdez et al., 1999, p 7). With equal access to high-quality remediation software, disadvantaged groups can especially benefit from this learning format (Roblyer & Edwards, 2000). These findings remind teachers of the importance of reflecting on the educational goal before technology is chosen for intervention purposes.

When one considers that even as late as 1998, just over half of teachers had Internet access at home (Becker, Ravitz, & Wong, 1999), lack of technical expertise was widespread. Often computer aides, known as specialists, were hired to demonstrate software programs in the classroom and to assist students in the makeshift computer labs. The computer specialist was frequently one of the only staff members who had technical knowledge and often faced resistance from educators reluctant to implement changes. It was not unheard of for a student’s knowledge base of technology to exceed the staff’s especially
if the student had access to a home computer. Often the focus was on simply learning the basics of how to utilize the hardware such as turning on monitors and central processing units, loading software, and controlling input with a mouse. These basic techniques had to be mastered before the learning of software applications could occur. Much of instructional time was taken in the logistics of the hardware. However, these basic computer skills laid the foundation of technical knowledge needed as technology implementation transitioned to the second phase of computer usage in education. Furthermore, and more importantly, research upheld that school-based computer applications resulted in an improvement in the attitudes of students toward school and subject matter (Roblyer, 1989; Roblyer & Edwards, 2000). Any educator experienced in using computers with students can validate this result. These combined findings of successes with technology undoubtedly served to cement technology’s place within the classroom.

A More Learner-Centered Shift in the Early to Mid-1990s

Surprisingly, some of these same challenges still exist although the technical environment has radically shifted. Fifteen years later, a class was observed with five computers lining one wall. When the teacher was asked how often the computers were used, she indicated they were not. The explanation given was that it was hard to find separate activities for the rest of the class while five worked on the computers. One would consider that this dilemma might have effectively been eliminated with the development of networked computer labs capable of simultaneously providing instruction to entire classes. When the same instructor was asked if the labs were utilized, the response was that there had been so many technical problems in the labs over the last few years that they had gradually quit going. The payoff just was not worth it. Clearly, in and of itself, access to state-of-the-art technology does not enhance learning. The role of the teacher is still pivotal. Staff expertise must go far beyond the basics of understanding the hardware and software. Knowledge needed includes types and purposes of software and appropriate uses of productivity tools by adopting a more learner-centered approach.

Successful integration of technology requires effective uses of learning theories and content-specific approaches to curriculum development. According to Valdez et al. (1999) the second phase of technology use in education can be characterized as a shift to a focus on learner-centered practices that dominated the learning environments of the early to mid-1990s. These practices include cooperative efforts and the creation of products for public perusal,
commonly known as multimedia applications. The advantages notable from this type of computer use are still central to the current learning environment. Students can use technology to access and evaluate large volumes of information to solve complex problems. Motivation is increased as students use computers to inquire into topics of interest (Roblyer & Edwards, 2000). This is evidenced when computer lab time is over and the teacher has to usher students out because they are so engaged in learning that they do not want to leave. Learning becomes student rather than teacher-directed. By sharing real data with experts, students begin “thinking and working the way experts do” (Valdez et al., 1999, p. 11). One of the challenges teachers face as students access the wealth of data is ensuring that students credit appropriate resources. Overall, both students and teachers benefit from increased productivity, efficiency, and organization.

Internet Shifts Focus to Higher Order Thinking in the Late 1990s

It is worthy to note that perhaps the greatest challenge in the current era of technology use is moving beyond simply increasing availability of technology. Ely looked to the future when he advocated using “technology to restructure schools or to teach higher order thinking” (Valdez et al., 1999, p. 14). Obviously, teachers will need varied opportunities and training to increase their professional skills in order to achieve this objective. Currently, this third phase places a focus on data-driven virtual learning, according to Valdez et al. (1999). Although the Internet has become integral to daily activity, it is important to reflect that widespread access and convenient usage is a relatively new development. One website that offers a particularly relevant timeline is http://www.zakon.org/robert/internet/timeline/. Adequate equipment and ongoing funding is a perpetual challenge considering the rate of technological advances. Due to the cost, increased accountability and verification of student benefit is being demanded by the public (Johnson & Bartleson, 2001; Valdez et al., 1999). These current challenges in education are reflected as Internet usage increases, promoting teachers to use technology to move to higher order thinking applications and to adapt technology to meet the demands of the standards movement.

The data-driven virtual learning provided by the Internet has transformed many districts. One such Technology Plan (Decatur School District 61, 1998) reflects the modifications brought about by the third phase of technology integration. Clearly, the technology
hardware and infrastructure was updated to state-of-the-art for the time. Not only were mobile personal computers available for in class use, but also every elementary school had one computer lab, middle schools had two, and high schools offered two to three. Each personal computer was connected to the Internet through high speed access lines enhanced by proxy servers. Decatur Schools District indicated that Cisco and Novell believe that this public school has the largest, most complete networking infrastructure in the nationwide public school system. COMPAC Netelligent Case Study also promoted the district’s Fast Ethernet technology for “opening up a world of educational possibilities and placing them at the top of the class” (Decatur Schools District 61, 1998, p. 4). Districts must constantly assess and evaluate technology applications in order to provide a state-of-the-art learning environment.

In planning, districts must allow for how they will fund updates and provide ongoing staff training to make effective use of the technology available. This valuable objective for all schools is reflected in the technology mission statement of “developing lifelong learning opportunities utilizing the latest technology with training, support services, and access to local and global networks” (Decatur School District 61, 1998, p. 5). Although leasing hardware is an option to consider, one must weigh the package proposal to ensure that it includes operating system upgrades, software upgrades, and data transferability from the old technology to the new. Being able to provide up to date hardware is an ongoing challenge faced by schools.

However, educators must not rely strictly on state-of-the-art technology as the means to promote effective teaching and learning strategies. This moving target of the latest and best quickly becomes obsolete by today’s standards. Gerry Beimler’s Technology Taxonomy (Decatur School District 61, 1998) has current relevance as an outstanding example of the challenge to reach the top of the hierarchy of teacher effectiveness.

- **Knowledge-level teachers** are aware of computers and may be users or non users. They are capable of following well-written key-by-key directions.
- **Application-level teachers** are willing to use or allow students to use applications, but leave instructional control with the software.
- **Analysis-level teachers** are capable of extracting portions of applications to assist in student achievement of identified curriculum objectives.
- **Synthesis-level teachers** can merge classroom instruction, relevant on-line instructional techniques, and supplementary materials.
• Evaluation-level teachers create and appraise classroom opportunities for learning beyond the design of instructional software and accompanying curriculum materials (Decatur School District 61, 1998).

In technology integration, as with almost any curriculum innovation that is successfully implemented, the catalyst for accomplishment remains the teacher.

The newest challenge is to use technology to individualize instruction to help students meet standards. Teachers should consider using technology to adjust content to students’ individual learning styles to achieve this goal. A meta-summary by (Valdez et al., 1996) verified that students put more effort in tasks that incorporate technology. Studies also show that technology positively affects students’ attitudes toward school, self-image, and self-confidence (Roblyer, Castine, & King, 1988). Properly implemented technology use offers schools an opportunity to transform the learning environment helping students to meet standards as a result.

For technology integration to be effective in the classroom, the following guidelines can be summarized from the three phases of technology evolution. Teachers must receive adequate ongoing training, technology use must be matched to the curriculum’s philosophy and theory of learning, and adequate numbers of computers must be conveniently located within the classroom. As McNabb (2001) notes, computers improve learning when there is “alignment of curricular goals and technology uses and assessment measures that capture evidence that learning has occurred” (p. 52). Addressing these challenges should enable schools to transition into a new phase of technology innovation.

Current Challenges as We Move to a New Era

Up until recently, research in technology has focused on the debate between computerized learning versus non-computerized learning. A shift is occurring to concentrate on “developmentally appropriate uses of technology for different age spans and content areas” (McNabb, 2001, p. 50). The International Society for Technology in Education (2000) offers a summary of the current challenges that must be addressed in order to maximize a technology integrated learning environment. They are:

• Visions with support and proactive leadership from the education system
• Educators skilled in the use of technology for learning
• Content standards and curriculum resources
• Student-centered approaches to learning
• Assessment of the effectiveness of technology for learning
• Technical assistance for maintaining and using technology resources
• Community partners who provide expertise, support, and real-life interactions
• Ongoing financial support for sustained technology use
• Policies and standards, supporting new learning environments (p. 4).

It is clear that many of the issues related to technology have existed since the inception of classroom applications and continue to be ongoing. Never has there been a greater need for knowledgeable staff and a critical evaluation of technology resources.

All players in the educational arena need to be knowledgeable about effective uses of technology. Shields and Behrman (2000) highlight teacher training as critical to quality implementation. Johnson and Bartleson (2001) suggest that a neglected group in the acquisition of computer skill acquisition is the school administrators. It would be advisable for districts to improve organizational effectiveness by offering training to improve communication, planning, and record keeping. A personal understanding of technology is necessary for principals, superintendents, directors, and other educators to maximize the goal of providing proactive leadership.

One way for educators to meet the challenges of skillfully and effectively using technology for learning is to be knowledgeable about evaluating technology resources. Johnson (2001a) highlights the Educational Software Preview Guide available at www.iste.org/L&L as an outstanding source. There are several key issues when evaluating software. The content should be culturally unbiased, current, appropriate to the curriculum standards, and promote student interest. Allowances for learning styles and age appropriateness are necessary. Perhaps the most important quality is the provision of clear ways to seamlessly integrate the software into lesson strategies. Because of these challenges, it is advisable for districts to offer resources to streamline the software review process for the classroom teacher, such as by using computer specialists or coordinators who can research and make appropriate recommendations.

Perhaps the best way for educators to meet the demands as we transition to the future is to reflect upon the lessons learned in the last 20 years. When the choice is made to use technology, we must pay
attention to unfolding research describing best practices for each content area and age grouping. Being able to document academic improvements directly related to technology use may provide the best strategy to ensure funding and community support. Lastly, educators must be role models by staying abreast of technology innovations and by demonstrating habits of lifelong learning.

FUTURE TRENDS AND CHALLENGES

Zenger and Zenger (1999) highlight anticipated technology issues as we move into the twenty-first century. Technology will be the impetus in determining how and what a teacher will choose for instruction. Classroom management must change as students use individual power pads.

Basic literacy skills will be accessing, thinking, and communication. Students will need to understand global economy and international business. High standards will be held for all with intervention strategies, such as apprenticeships for struggling students including adaptations for students with special needs. Ornstein and Hunkins (1998) describe this ability to customize information to students’ “learning styles, their cultural backgrounds, their educational interests and their academic goals” (p. 374). Because every job will require information technology skills, lifelong learning will be critical. To meet the demand, schools may be open longer each day and throughout the year contributing to a continued priority of securing funding. These changes may encourage more parental input in school decisions. Clearly these visions are quickly becoming realities—realities that match the requirements for future technology implementation outlined by the International Society for Technology in Education (2000). Educators are rapidly serving a generation of students who enter their formal schooling with a better understanding of computers than high school graduates possessed not many years ago. How we meet these challenges will lay the foundation for future technology strategies.

The curriculum in the twenty-first century will be adapted to correlate with real-world requirements. Lewis (Zenger & Zenger, 1999) predicts we may see computers in desktops, students with personal computers, and video wallpaper. Different projections from Berliner (Zenger & Zenger, 1999) include textbooks on disks, advanced graphing calculators, communication networks from home to school, teachers roles changing to facilitators, and individual and group projects. Reigeluth (Zenger & Zenger, 1999) further highlights a Montessori approach, outcomes-based learning, individual testing, and personal
learning plans. In addition to the actual technology tools, Reigeluth says we can expect changes such as teachers working with the same students over a period of years, smaller schools, and contracts of commitment from students. A new paradigm to stimulate thinking will emerge. Social services will become an extension of the school environment. Hammond (Zenger & Zenger, 1999) reiterates many of the above contentions but adds that the bioengineering age will further impact students’ drive to learn. Adaptability will be a necessary skill. Cornish (Zenger & Zenger, 1999) offers possible future developments such as training in cribs, virtual-reality, automated tutors, personal help with homework, and global universities. Finally, Halsted (Zenger & Zenger, 1999) encourages addressing the outdated layout of nineteenth century buildings as we adapt to these changes. When one considers the consensus of these researchers in technology development, it becomes evident that technology has the power to reinvent the way the educational product is delivered.

Educators need to prepare students for a technical world requiring self-initiative in learning, precision in processes, and the ability to identify and analyze pertinent information. Further, we must remain cognizant that complex problem-solving skills become increasingly valuable compared to the memorization of facts. Research is needed to ensure that other psychological and social issues in child development are considered as new technology strategies are implemented. We must ensure that students do not lose the nuances of interpersonal communication as they become more technically oriented. Ornstein and Hunkins (1998) summarize these concerns by cautioning that we must avoid a misuse of technology, denying students “the opportunity to engage in his or her own creative participation, to experience a real field experience, [and] to seek answers to his or her questions” (p. 374). Clearly, highly trained classroom teachers are needed to determine the most appropriate instruction strategy for each situation and to balance exposure to the various options.

Shields and Berhman’s (2000) analysis of research offers several related cautions in this educational future filled with increased computer technology integration. There is a need to better understand the impact that technology has on the social and emotional development of children. With the current push for computer access in schools, faculty guidance and facilitation of content becomes crucial. Additional research is encouraged in the most appropriate strategies for content area knowledge acquisition. Educators must be aware of potential physical effects of overuse such as eyestrain and repetitive stress injuries. Additionally, faculty should recognize that computers are tools and whether they serve to improve lives depends on how they are
used (Shields & Berhman, 2000). Zenger and Zenger (1999) also caution us to avoid believing that technology is a solution to all problems. Research must now focus on developing standards to implement technology into the curriculum.

One also should consider the impact that information technology will have on society, including globalization and democracy. Cerf (1999) reminds us of the need to protect the free exchange of information on the Internet. His concerns proved prophetic as restriction increased after the events of September 11. Because the Internet serves as a repository for the accomplishments of our society, we must ensure that it remains affordable, unrestricted, accessible, and supported by the proper infrastructure. Cerf (1999) suggests that a global framework of laws should be developed to protect its use. Measures need to be taken to protect privacy and to create protected content areas for the young (Cerf, 1999; Robyler & Edwards, 2000). If these goals are achieved, they will serve to unite the world in the process of globalization while promoting democratic ideals.

By reflecting on the cumulative best practices of technology integration and by avoiding ineffective practices, educators are better able to “make research-based decisions regarding the most beneficial approaches to technology… in educational settings” (Valdez et al., 1999, p.iii). We must recognize the speed with which technology progresses and be responsive by adjusting our techniques as necessary. It also is appropriate to acknowledge that some technology applications remain constant when properly inserted into an aligned curricular plan. Although technology offers educators one of the most powerful allies impacting how education is delivered and supplemented, the ultimate success of our schools still remains in training and supporting quality, irreplaceable frontline teachers.

REFERENCES


